

INDIAN SCIENCE CONGRESS
CALCUTTA, 1952
PART IV.





PROCEEDINGS
OF THE
THIRTY-NINTH
INDIAN SCIENCE CONGRESS
CALCUTTA, 1952

PART IV.

LATE ABSTRACTS, DISCUSSIONS, LIST OF
MEMBERS AND INDEX.



*Published by the Indian Science Congress Association,
1, Park Street, Calcutta - 16.*

1952

PROCEEDINGS OF THE THIRTY-NINTH INDIAN SCIENCE CONGRESS

CALCUTTA, 1952

PART IV.

C O N T E N T S

		PAGE
1.	LATE ABSTRACTS	
	Section II. Statistics	1
	„ III. Physics	2
	„ IV. Chemistry	22
	„ VI. Botany	23
	„ VII. Zoology & Entomology	34
	„ VIII. Anthropology & Archæology	38
	„ X. Agricultural Sciences	39
	„ XI. Physiology	51
	„ XIII. Engineering	55
2.	DISCUSSIONS	
	Analysis of Time Series	85
	Statistical Methods in Population Studies	89
	Co-ordination of Official Statistics	91
	A Discussion on the Subgeneric Position of Phlebotomus	98
	Occurrence of Curiously Modified Spines on the Pulp of Psychoda	99
	Parasites of Phlebotomus	99
	Symposia on Soil Research Under the Auspices of the National Institute of Science in India-January, 1952	100
	Symposium on "Red Rot of Sugarcane"	108
	Symposium on Animal Nutrition and Human Nutrition in Relation to Crop Planning in India	108
	Etiology of Diabetes	113
	Fermentation Technology	117
	Microfossils and the Determination of the Age of Sedimentary Rocks	118
	Geography of Crop Plants	126
	Education of Youth	131
	Thoughts on Hirakund Dam Project	135
	Acid Steel Making in India	139
	Manufacture of Synthetic Pig Iron	144
	Effects of Different Limestones on Basic Open Hearth Production	152
	A Symposium Service Problem on Overhead Transmission in West Bengal	155
	Service People on Overhead Transmission in West Bengal	159
	List of Members	1
	Index	143

PROCEEDINGS OF THE THIRTY-NINTH INDIAN SCIENCE CONGRESS

CALCUTTA, 1952.

PART IV

LATE ABSTRACTS

Section II.: STATISTICS.

1. Statistical Examination of Losses on Upper Ganga Canal.

A. P. BHATTACHARYA, Roorkee.

A study has first been carried out of the series of terms containing monthly losses due to seepage, transpiration, evaporation, etc. on the Upper Ganga Canal in a length of about 195 miles from Dhanauri (near Hardwar) to Sikendra Rao (near Aligarh) for the period 1932-49 both in the entire reach and sub-reaches in between four gauging stations, Dhanauri, Belra, Niwari and Sikandra Rao. A significant rise in losses has been established during the above period. An analysis has not been carried out regarding the effects of the possible causes of the increase in losses, which were thought to be :—

- (i) increased seepage as a result for raising of banks due to the construction of power houses on the Canal,
- (ii) increased seepage as a result for raising of banks due to the steeper gradients of inflow lines,
- (iii) rainfall and
- (iv) temperature.

No conclusive results were obtained for the first sub-reach from Dhanauri to Belra, which has no tubewell pumping in its vicinity, while for the other reaches it has been mostly tubewell pumping and to some extent its cumulative effect along with the raising of banks due to the construction of power houses which have generally affected the rise in losses. It has also been found that a lot of observational errors have crept in the measurement of discharges which form the basis of computing losses.

Section III.: PHYSICS.

1. Stellar Model with Large Radius.

TOPENDRA CH. ROY, Calcutta University.

A model of star is constructed having a convective core and radiative envelope and of non-homogeneous composition

It is shown that to get a radius as large as was found by Li Hen and Martin Schwarchild it is not necessary to have a wide variation in chemical composition as was worked out by them. The models have the characteristic that K_0 remains the same throughout the star where K_0 is contained in the opacity law $K = K_0 G T^{-3.5}$.

2. Study of Yarn Characteristics with Special Reference to the Region of Yarn Rupture.

C. NANJUNDAYYA, Bombay.

Study of the yarn features at the point of rupture is very important. For purposes of this study, cotton yarn with dyed fibres mixed with raw fibres in a certain proportion was spun. 2" of this yarn were mounted on a specially designed metallic slide, and the twist angle and diameter at intervals of 1 mm. were mapped out throughout its length. The breaking load of this specimen was determined on a specially designed instrument. Further the number of fibres that break and the number which naturally occur in the yarn cross-section were determined by Congo Red Method. The results are discussed and conclusions are drawn relating to yarn strength.

3. Proton-Proton Scattering Contribution of the p-Wave.

P. L. KAPUR, Delhi.

The experimental data on proton-proton scattering has been studied with a view to finding the contribution of the p-wave on the assumption that the observed cross sections are due to s and p-wave scattering only. Assuming only central p-scattering, one finds that in laboratory frame of reference for a scattering angle of 45° the contribution of the p-wave is identically zero. The fitting of the theoretically expected value for the scattering cross-section with the experimentally observed value at 45° thus fixes the phase shift K_0 . Assuming the value of K_0 the values of the contribution of the s-wave to the scattering at various angles is calculated. The difference between this theoretically calculated value and the experimentally observed value gives the contribution of the p-wave.

The results are presented.

4. The latitudinal oscillation of a barometric trough and associated weather over Bengal during the Indian summer.

K. R. SAHA, Calcutta.

During the premonsoon months of March to May, a quasi-stationary trough of barometric pressure oriented more or less in a W-E direction lies over Bengal as part of the seasonal low pressure over India during this period. It occupies a mean position of about Lat. $23\frac{1}{2}^{\circ}\text{N}$ in April and gradually shifts northward with the advance of the summer. During the summer of 1946, a kind of regularity was suspected in the movement of the trough line and its probable association with the weather of Bengal. It was also apparent that the manner in which weather formed in association with the trough line had the semblance of some kind of frontal action between two air masses. A detailed investigation was, therefore, undertaken to study the air mass or air masses on either side of the trough line based on available aerological data of Calcutta and Lalmonirhat and the air flow over Bengal. It appeared to show that the E'ly air to the north of the trough line is somewhat cooler and drier than the S'ly tropical maritime air to the south. This study enabled rough conclusions to be drawn regarding the relative spacial disposition of the air masses over Bengal during this period. The movement of the trough line was studied by taking a suitable system of reference formed by a latitude and a longitude and by noting the position of the trough line on the longitude at definite intervals of time. In the present investigation the base line chosen was Lat. $22\frac{1}{2}^{\circ}\text{N}$ and the ordinate was long. 89°E . This particular reference system was chosen because of the close proximity of the origin to Calcutta. The position of the trough line was determined at two fixed hours daily, viz. 0230 and 1130 hours G. M. T., and the weather at Calcutta was noted at each of these hours. A graphical representation was then obtained by plotting the position against the days of the month and by noting the weather at Calcutta in symbols on the base line. In this way studies were made of data of years 1942-43 and 1945-46. The movement curves appeared to lead to the following tentative conclusions :—

- (1) the latitudinal movement of the trough line is oscillatory in character ;
- (2) the period of oscillation appeared to vary from about 8 days in April to a somewhat longer period in May ;
- (3) the maximum amplitude of the oscillation is about 4 degrees of latitude ;
- (4) the axis of oscillation shifts northward with the advance of the premonsoon season ;
- (5) the oscillatory movement is disturbed, though temporarily, by the passage of Norwesters and Western depressions ;
- (6) when the trough line lies far north of Calcutta, the weather is fine over the city on most occasions except when a Norwester or a Western depression affects the area but whenever it lies on, or in the vicinity of, the city the weather over the city gets disturbed on most occasions, and, lastly ;
- (7) the correlation between the weather at Calcutta and the position of the trough line on or near Calcutta appears to be high.

Roy in a paper on the "Forecasting of rain over south Bengal during the Norwester season, mid-March to mid-May" correlated a very high frequency of

rainy days over south Bengal with the simultaneous existence of higher barometric pressures at Barisal and Berhampore than at Calcutta and concluded that the favourable condition of a higher barometric pressure at Berhampore than at Calcutta indicated the probable presence of dry and perhaps somewhat cooler land air to the north of deltaic Bengal at some upper level, if not actually on the ground, and perhaps its movement towards deltaic Bengal. The present investigation would appear to lend support to this conclusion in that a simultaneous existence of a higher barometric pressure at Berhampore and Barisal than at Calcutta is only possible when the W-E trough line lies over south Bengal, *i.e.*, south of Berhampore. The movement suspected by Roy also appears to be confirmed. But the results of the present investigation would appear to be more general and far-reaching in character. They would seem to indicate some kind of order in a distribution of rain and other types of weather over Bengal during the period which was previously believed to be random in nature. In the course of the present investigation it was found that the trough line moves in the direction of the isallobaric gradient and the speed of the movement is proportional to the magnitude of the gradient. Isallobaric wind analysis at frequent intervals of time, say, over every 3 or 6 hours, should, therefore, enable the movement of the trough line to be forecast and followed closely for forecasting the associated weather.

The effect of the diurnal oscillation connected with the land and sea-breeze on the movement of the trough line has not been taken into consideration in the present investigation.

5. Solar Geomagnetic Relationship from a study of Kodaikanal Records (1949-1951)

M. V. SIVARAMAKRISHNAN,

The paper presents an account of the solar geomagnetic relationship from a study of Kodaikanal records for the period 1949-1951. The geomagnetic field variations at Kodaikanal have been analysed as follows :

- (1) Solar flares and geomagnetic storms ;
- (2) The time travel of solar corpuscles *i.e.*, the time interval between onset of flare and onset of geomagnetic storm ;
- (3) Recurrence feature of some of the great storms recorded at Kodaikanal ;
- (4) Sudden commencements in geomagnetic field variations ;
- (5) Geomagnetic crochets recorded during 1949-1951 and allied radio and solar effects ;
- (6) The diurnal variation of 'H' at Kodaikanal.

During sudden commencements the Kodaikanal magnetograms show a simultaneous increase in both 'H' and 'V' and in certain cases during storm time variation, a decrease in 'D' westerly synchronous with increase in 'H' and 'V' has been noticed, which is rather unusual for this latitude. Some of the sudden commencements recorded at Kodaikanal are not recorded at other observatories. From the study of about 52 cases of sudden commencements at Kodaikanal, it is seen that a marked minimum around 08 hours and 20 hours local time is observed as suggested by Newton. Kodaikanal (geomagnetic longitude : 118.2°) magneto.

grams do not show even a single case of the second type of sudden commencement (i.e., increase in 'H' preceded by a small movement in the opposite direction) and so this does not agree with the suggestion made by Ferraro and Parkinson. The recurrence feature of some of the great storms recorded at Kodaikanal has been discussed as well as the anomalies noticed in the geomagnetic effects of solar flares and abnormal diurnal variations of 'H' at Kodaikanal.

6. Diurnal magnetic variation in equatorial regions.

S. K. PRAMANIK and S. VEGNARAIN

The diurnal variation of the horizontal magnetic force in the equatorial regions is markedly large. The data available are however, meagre and only from a few stations. The International Commission for Terrestrial Magnetism and Electricity recommended in 1948 that observation of the diurnal range of the horizontal force, H , be taken at other places in the equatorial regions. In 1950 Gulatee arranged for some observation of diurnal range of H at 5 places in South India and Ceylon for 2 to 3 days at each place, and in 1951 the authors of this note arranged for hourly and bihourly observations of H and Z at 3 places in South India for a week at each place. The data of these observations have been studied and the main conclusions are as follows:—

- (1) The diurnal range of H in South India was about 135 γ in March 1951 and 80 γ in June—July 1950.
- (2) The geographic and magnetic equators are about equally far apart near Batavia and Singapore, and in South India, but the diurnal range of H is considerably greater in South India.
- (3) The maximum range of H in South India is not between the magnetic and geomagnetic equators but to the south of both.

7. A Criterion of Stability in Servomechanism System.

H. TISCHNER, Kharagpur.

1. The Problem.

A linear servomechanism system containing discrete and unsteady elements as masses, springs, inductors, capacitors and resistors is described by an ordinary differential equation of the order n if the system contains n accumulators of energy. The differential equation of the proper vibrations is

$$a_n \ddot{\xi}^{(n)} + a_{n-1} \dot{\xi}^{(n-1)} + \dots + a_1 \dot{\xi} + a_0 \xi = 0. \quad (1)$$

In this equations ξ is the deviation of the output of the system related to a constant value and $\dot{\xi}^{(v)}$ the differential quotient to the time t . The coefficients a_n contain the size of the accumulators of energy and of the resistors and other damping devices of the servomechanism system. In modern servomechanism systems the

order of the differential equation is often high. The solution of equation (1) is always a sum of exponential functions of the form

$$z = \sum_{v=1}^{v=n} \alpha_v e^{p_v t} \quad (2)$$

The values α_v and p_v may be obtained from the differential equation. Generally the values p_v are complex so that we can write

$$p_v = \beta_v + i \omega_v \quad (3)$$

There are β_v the attenuation factors and ω_v the radian frequencies of the proper vibrations of the servomechanism system. If β_v is positive the vibrations swing up; at negative values the vibrations die away. The complex frequencies p_v are to be calculated from the differential equation as the roots of its characteristic equation

$$a_n p^n + a_{n-1} p^{n-1} + \dots + a_1 p + a_0 = 0 \quad (4)$$

assuming that the initial conditions are all zero. This can be derived by the method of Laplace transform. If all roots p_v of this equation have negative real part, the system is stable and can be used as a servomechanism system. But if only one of the roots has a positive real part, the system becomes an oscillator and cannot be used for servomechanism purposes. Therefore the first thing in the design of such a system is the question of stability. This means that the characteristic equation cannot contain any root with positive real part or real part equal to zero. It is wellknown that the exact solution of equation (4) is a long and tiring work if the equation is of higher than the fifth degree. But for the preliminary studies it is not necessary to calculate the roots which are in most cases conjugate complex; it is sufficient to know the sign of their real part.

Since the very beginning of the studies in servomechanism systems efforts have been made to obtain a simple criterion for the sign. The problem was raised by J. Clerk Maxwell and further investigated by N. J. Routh. The coefficients of equation (4) are real as the roots are always conjugate complex or purely real. Since a long time it was wellknown that the coefficients a_v must be positive if all parts of the roots are to have a negative real part. But this condition is not sufficient. A. Hurwitz (1) stated that in addition to this the determinants

$\Delta_1 \dots \Delta_n$ defined by

$$\Delta_1 = a_1; \Delta_2 = \begin{vmatrix} a_1 & a_0 \\ a_3 & a_2 \end{vmatrix}; \Delta_3 = \begin{vmatrix} a_1 & a_0 & \sigma \\ a_3 & a_2 & a_1 \\ a_5 & a_4 & a_3 \end{vmatrix}; \dots$$

$$\Delta_n = \begin{vmatrix} a_1 & a_0 & \dots & \sigma \\ a_3 & a_2 & \dots & \sigma \\ \dots & \dots & \dots & \dots \\ a_{2n-1} & a_{2n-2} & \dots & a_n \end{vmatrix} \quad (5)$$

must be positive. If the determinant Δ_{n-1} has a positive value then Δ_n has a positive value too so that only all determinants upto Δ_{n-1} must be calculated.

(1) A. Hurwitz, *Mathematische Annalen* 46, 273, 284, 1895.

Although those determinants can be calculated (the accuracy got by slide rule is not sufficient) the amount of time involved is considerable. In spite of the elegant mathematical form of the determinants the value of the method is not great for practical calculations of equations of a high degree. In literature this criterion is often cited but, really, it is only to be used for relatively simple servomechanism systems.

Graphical methods have been developed by H. Nyquist (2) and F. Strecker (3) about the same time. For characteristic equations of a high degree these methods are really not much simpler than that of the determinants.

L. Cremer (4) and A. Leonhard (5) developed a simpler criterion regarding the behaviour of equation (4) for purely imaginary values of the complex frequency p in an Argand diagram. A graph of the equation is necessary. It has been found by experience that the design of this graph needs much time and it seems desirable to seek for another criterion which can be handled in an easier manner by non-specialist people too.

In the following sections a method is described by which the stability of servomechanism systems may be judged. One of the advantages of the method described is that the process is self-acting to a certain degree when use is made of a relatively simply constructed synthesizer of Fourier series.

2. The Method.

As mentioned above all roots $p_v = \beta_v \pm i\omega_v$ of equation (4) have a negative real part in stable systems. Therefore they are situated within the left half of the p -plane (Fig. 1a). By the bilinear Moebius' conformal representation

$$q = r + i s = \frac{p - 1}{p + 1} \quad (6)$$

the right half of the p -plane is transformed into the interior of the unit circle C of the q -plane as seen in Fig. 1b. Parallels to the w -axis correspond to circles $\beta = \text{const.}$, with their centers on the real axis and touching the unit circle at $r = +1$. Parallel lines to the β -axis are represented by circles with their centers on a line $r = +1$ parallel to the s -axis. They touch the point $r = +1$ also. For $\omega = 0$ the circles are mapped into a straight line and for $\beta = -1$ the radius of the circle becomes infinity. The circles for $\beta < -1$ appear at values $r > +1$. As the circles $\beta = \text{const.}$ and $\omega = \text{const.}$ are rectangular to each other all circles of the q -plane cut themselves at right angles.

For stable servomechanism system ($\text{Re } p_v < 0$) the inside of the unit circle is free of roots as the absolute value of the roots of the p -plane mapped into the q -plane is larger than 1.

If the representation (6) is applied to the equation (4) we get an equation in q of the same degree. The degree of the equation is diminished only when

-
- (2) H. Nyquist, *Bell System Technical Journal* 11, 126-----147, 1932.
 - (3) F. Strecker, *die elektrische Selbsterregung mit einer Theorie der aktiven Netzwerke*, Stuttgart 1947.
 - (4) L. Cremer, first given as a paper to *Servomechanism Experts of Germany* in 1943 and later published in *Zeitschrift fuer angewandte Mathematik und Mechanik* 25/27, 1947.
 - (5) A. Leonhard, *Archiv fuer Elektrotechnik* 38, 17-----28, 1944.

the roots are equal to $+1$. As the coefficients of the equation (4) are real the new equation also has real coefficients. This means that the roots of both equations are either real or conjugate complex.

It can be demonstrated that the coefficients b_v of the transformed equation

$$b_n q^n + b_{n-1} q^{n-1} + \dots + b_1 q + b_0 = 0 \quad (7)$$

are given by

$$b_v = \sum_{\tau=0}^n a_{\tau} \sum_{\substack{n-\tau \leq v \\ v-\tau \geq 0}} (-1)^{n+\sigma} \binom{n-\tau}{\sigma} \binom{\tau}{v-\sigma} \quad (0 \leq v \leq n) \quad (8)$$

Table I contains these coefficients b_v as function of the coefficients a_v . They have been calculated for use up to the tenth degree. In any practical case the calculation of the coefficients b_v is a simple matter consisting only of elementary operations.

The roots of the equation (4) and (7) are not known. But it is not necessary to know them; for our purpose it is sufficient to prove that the inside of the unit circle of the q -plane is free of roots if we like to have a stable system or to see how many roots are situated within the unit circle for the oscillating systems.

We may write the equation (4) as a power series

$$f(p) = a_n p^n + a_{n-1} p^{n-1} + \dots + a_1 p + a_0 \quad (9)$$

By introducing the Moebius' representation (6) we get the series

$$g(q) = b_n q^n + b_{n-1} q^{n-1} + \dots + b_1 q + b_0 \quad (10)$$

Putting $q = r e^{i\Psi}$ we get a closed curve in the q -plane. With $r = 1$ the power series 10) becomes a real and an imaginary part. It is

$$\operatorname{Re} g(q) = b_1 \cos \Psi + b_2 \cos 2\Psi + \dots + b_n \cos n\Psi + b_0 \quad (11)$$

$$\operatorname{Im} g(q) = b_1 \sin \Psi + b_2 \sin 2\Psi + \dots + b_n \sin n\Psi \quad (12)$$

Fig. 2 gives an idea of the character of the polynomial $g(q)$ for $r = 1$ (unit circle). An equation of the fifth degree has been chosen. Four roots are supposed to be constant; the fifth root varies from $p_5 = -2$ to $+0.5$. The curves are symmetrical about the real axis as the coefficients are real. This means that only the values from $\Psi = 0$ to $\Psi = \pi$ are to be calculated. The character of the curves changes with the numerical values of the root p_5 . It is essential that this change is large in the neighbourhood of $p_5 = 0$. The inner loop of the curve at $p_5 = -0.05$ goes rapidly through the imaginary axis and bisects it at positive values of p_5 . This is due to the chosen Moebius' representation. In Fig. 1a two squares in the p -plane are indicated. They are mapped into the corresponding surfaces of the q -plane. One small square near $\beta = \omega = 0$ is transformed into a relatively large area, whereas a large square near $\omega = \beta = 3$ only corresponds to a small area in the q -plane. So the chosen representation is sensitive to the environments of $\beta = 0$. This is important with respect to the problem as we are interested in knowing what happens near $\beta = 0$. Here is the boundary between the stable and the unstable case.

The principal question is now to prove the absence of roots in the right

p-half plane or in the inside of the unit circle of the q-plane for stable systems. As seen in Fig. 2 the curve representing the polynomial $g(q)$ of equation (10) intersects the negative real axis several times. We define the numbers of intersections of the negative real axis as the number of windings of the curve. If the curve intersects the negative real axis in a positive sense once, this number is equal to $+1$; if the curve runs clockwise through this axis the number is -1 .

According to Cauchy the integral

$$\frac{1}{2\pi i} \left(\oint \frac{g'(q)}{g(q)} dq \right) \quad (13)$$

gives the number of zeros N of the function $g(q)$ supposed that it is regular as in our case. Putting $g(q) \equiv \zeta$ we get

$$\frac{1}{2\pi i} \left(\oint \frac{g'(q)}{g(q)} dq \right) = \frac{1}{2\pi i} \left(\oint \frac{d g(q)}{g(q)} \right) - \frac{1}{2\pi i} \left(\oint \frac{d \zeta}{\zeta} \right) \quad (14)$$

If $q = r e^{i\Psi}$ represents a circle of radius r , then ζ will be a closed curve which has already been demonstrated for $r = 1$ by Fig. 2. Let us consider the behaviour of such a curve near the negative real axis (Fig. 3). The curve intersects this axis at the point $-\alpha$. The points α_1 and α_2 are on the one side respectively or on the other side of the axis according as $\Psi < \pi$ or $\Psi > \pi$. Corresponding to the definition of the logarithmic function we have

$$\int_{a_1}^{\alpha_1} \frac{d\zeta}{\zeta} = \int_{\alpha_2}^{a_2} \frac{d\zeta}{\zeta} = \ln \alpha_1 - \ln a_1 = \ln a_2 - \ln \alpha_2 \quad (15)$$

If α_1 and α_2 approach the point $-r$ we get

$$\ln \alpha_1 \rightarrow \ln(-r) = \ln r + i\pi \quad (16a)$$

$$\ln \alpha_2 \rightarrow \ln(-r) = \ln r - i\pi \quad (16b)$$

therefore

$$\int_{a_1}^{a_2} \frac{d\zeta}{\zeta} = \ln a_2 - \ln a_1 + 2\pi i \quad (17)$$

We close now the curve by putting $a_1 = a_2$ and get

$$\frac{1}{2\pi i} \left(\oint \frac{g'(q)}{g(q)} dq \right) = \frac{1}{2\pi i} \left(\oint \frac{d\zeta}{\zeta} \right) = +1 \quad (18)$$

If the curve intersects the negative real axis m times in the positive sense and n times in the negative sense it follows that

$$\frac{1}{2\pi i} \left(\oint \frac{g'(q)}{g(q)} dq \right) = m - n - N \quad (19)$$

where $m - n \geq 0$. This expression represents at the same time the number N of roots of the power series (9) with positive real part. This number is now equal

to the numbers of windings of the polynom (10). The result was stated first by A. Hurwitz and R. Courant⁽⁶⁾.

For our special case we express this result in the following manner :

The point $q = e^{i\Psi}$ runs through a circle of unit radius in the positive sense. The polynom $g(q)$ will be a closed curve. The number of windings of the curve is equal to the number of roots with positive real part. This number must be zero if the servomechanism system is stable.

In Fig. 2 the numbers of windings is noted.

3. Application of the Method.

We have seen that the knowledge of the curve $g(q)$ near the negative real axis is essential to determine the absence of roots with positive real part. Therefore it is not necessary to draw the complete curve as usual in other geometrical criterions. It is sufficient to consider the sign of the Fourier series (11) and the points of zero of the series (12) as a function of Ψ . Only the change of sign of the sin-series within the range where the cos-series has negative values is of interest. So it is enough to know the negative values of the cos-series and the values of the sin-series within this region. Certainly it is not possible to avoid the calculation of the whole cos-series to get the negative values. No criterion exists for the points of zero of a Fourier series. But the calculation of the sin-series may be restricted to the negative ranges of the cos-series. Fig. 4 shows a diagram of the same equation of the fifth degree for which the conformal representation has been given in Fig. 2. The negative ranges of the cos-series are shaded. The arrows indicate the points of zero of the sin-series and the direction in which it is going through zero. The number of windings changes from $p_5 = 0$ as the cos-series becomes positive near $\Psi = \pi$. It is interesting to see that the points of zero of the sin-series are at a larger distance from $\Psi = \pi$ as the root p_5 becomes larger. Another example is illustrated by Fig. 5. An equation of the ninth degree has been chosen. The roots are $p_{1,2} = -1 \pm 12i$; $p_{3,4} = -2 \pm 13i$; $p_{5,6} = -3 \pm 14i$; $p_{7,8} = -4 \pm 15i$. The root p_9 is variable from $p_9 = -3$ to $+1$. We see that this simple graph gives us a complete survey on the positiveness of the real part of the roots of any algebraic equation.

The graphical process may be simplified by using an automatically working synthesizer of Fourier series. Such synthesizing devices have been used for the calculation of flood tides (7). Its principle (8) may be seen from Fig. 6 for a Fourier synthesizer of the first four harmonics. Four cross slide linkages $K_1, \dots, K_4$ are connected together by gears which have not been drawn. Generally speaking, if the crank of the linkage K_1 is turned through the angle Ψ , the other cranks $K_2, K_3, \dots, K_n$ are turned through $2\Psi, 3\Psi, \dots, n\Psi$ if there are n cranks. The distance of the cross slide linkages from the turning centers are adjustable corresponding to the different values of b_v in equation (10). So the curves of the sin values and the cos-values can be obtained by adding the movements of the cross slide linkages. The value b_v of equation (10) is controlled by the roll R. The curve is registered by the slide W. Only the values near zero of the curve are of interest. An amplitude limiting spring S is therefore useful.

4. Reduction of similar Criteria.

(6) A. Hurwitz und C. Courant, *Die Grundlehren der mathematischen Wissenschaften*, Vol. III *Funktionentheorie* Berlin 1922, p. 102.

(7) H. Rauschelbach, *Zeitschrift fuer Instrumentenkunde*, 44, 285, 1924.

(8) A. Walther, H. J. Dreyer, H. Estenfeld, *Zeitschrift fuer Instrumentenkunde* 59, 161-----168, 1939.

The criterion described in section 2 gives an idea of the stability of a servomechanism system. It is often desirable to get systems of a certain minimum attenuation β_0 . The roots of the characteristic equation (4) which have a real part smaller than β_0 may be found out by introducing the representation

$$p' = p + \beta_0. \quad (20)$$

A parallel line to the ω -axis of distance β_0 is mapped into the ω' -axis of the p' -plane (Fig. 7a). We get a new characteristic equation which may be treated in the same manner as above to find out the roots with negative real part. If we know that the characteristic equation (4) has no roots with positive real part and if we find that the transformed characteristic equation has n roots with positive real part, it is proved that the original characteristic equation has n roots of which the real part is smaller than $-\beta_0$.

A. Leonhard (5) proposes to admit only roots $p_v = \beta_v \pm i \omega_v$ of the characteristic equation wherein the attenuation factor β_v related to the radian frequency ω_v is not larger than a certain value. These roots are situated in a region of the p -plane bounded by the straight lines A and B (Fig. 7b). It is easy to verify that the representation

$$p'' = e^{i\pi \left(\frac{1}{2} - \frac{\delta_0}{\delta} \right)} \frac{1}{p\delta} \quad (21)$$

maps this region into the left part of the p'' -plane. Supposed $1/\delta$ to be a rational number, we get a finite Fourier series so that the procedure is the same as demonstrated above. In case $1/\delta$ is an irrational number, an infinite series is the result but principally the method of calculation need not be changed.

8. Recent Advances in our Knowledge of the Ionosphere.

S. K. MITRA, Calcutta.

Brief references to the advances in the knowledge of the ionosphere will also be noted.

1. Ionospheric regions of solar ultraviolet radiation origin.

Contemporary ideas regarding the origins of D, E, F_1 and F_2 regions are are tabulated below.

Region	Ionizing process
D	First ionization of O_2 at $\lambda \leq 1019\text{\AA}$ as originally suggested by Mitra, Bhar and Ghosh (12.2 eV).
E	Pre-ionization of O_2 at 1000-910 $\text{\AA}$ (Nicolet). Formed in the region of O_2 dissociation as suggested by Mitra and Bhar, and also independently by Wulf and Deming.
F_1	First ionization of O at $\lambda \leq 910\text{\AA}$ as suggested by Bates (13.5 eV).
F_2	Formed by bifurcation of F_1 (Bates and Massey ; Martyn).

The height distributions of ionization of the E and F₁ regions are approximately as expected from the simple Chapman theory. There are, however, significant departures. Also, the E-region has now been found to possess a fine structure.

The D region, though it has not an electron concentration peak, may have an ion concentration peak as shown by A. P. Mitra.

The intensities of ionization of the various ionospheric regions vary with solar cycle. According to the results of certain observations on the variation of E region ionization carried out during a solar eclipse it appears that the source of the ionizing radiation on the solar disc is the inner corona.

2. Sporadic E and G regions.

Sporadic E ionization is probably due to meteoric ionization. This is augmented in high latitudes by impacts of solar corpuscles as produce magnetic storms and auroras and in lower latitudes by thunderstorm effects. There has been difference of opinion regarding the structure of E_s — whether it has a thin layer structure, or, consists of 'patches' or 'blobs' of ionization. The latter view is now more favoured. For example, long and short-delay radio echoes as are observed within the skip distance with high power transmitters, are explained as due to scattering near the E-region due to a patchy structure. The problem of sporadic E is only partially solved.

A so-called G region at very great heights—above the F-region—has been reported from time to time. The origin, as also the actual existence of this region are still doubtful.

3. Ionospheric anomalies: Geomagnetic control: Association with magnetic storms (sudden commencement type).

The time variation of the average electron concentrations of the E and F₁ regions obey very nearly the $\sqrt{\cos \chi}$ law of Chapman (χ -zenith angle of the sun). There are, however, significant deviations from the same. The F₂ region does not at all obey the $\sqrt{\cos \chi}$ law and is notorious for its erratic behaviour. The region appears to be under strong geomagnetic control. There exists a belt of low values of F₂ ionization roughly along the geomagnetic equator encircling the earth. This becomes evident if the noon time critical frequencies of the stations north and south of equator are plotted against the geomagnetic, rather than the geographic latitudes.

Magnetic storms of the sudden commencement type are generally accompanied by ionospheric storms consisting of a depression of the ionization and an increase in the virtual height of the F₂ region. The recovery, after the magnetic storm is over, may be quick or slow according as the storm effect is observed in high or in temperate latitude. In temperate and equatorial latitudes there is, for one to two days before the sudden depression, an increase in the ionization density.

There are also other anomalies of the F₁ region, e.g. decreased day-time Nmax in summer and marked bifurcation of F₁ and F₂ in low latitudes; the so-called longitude effect, namely, two stations situated in the same latitude but in widely different longitudes show systematic differences in the average critical

frequencies and in the average heights of the region maxima. These anomalies are, at least partially, explained as due to geomagnetic control and tidal actions.

4. *Tides and Ionospheric Anomalies,*

The ionospheric regions participate in the atmospheric tidal oscillations due to the gravitational pulls of the sun and the moon. However, the tidal effects in the ionosphere are difficult to isolate for study: the lunar effect, because of its very small amplitude and the solar, because of the superposed ionizing action of the solar rays. Nevertheless, lunar tidal effects in the E and F_1 regions have been derived and are found to conform to the "dynamo theory" effects. For example, height oscillations of the base of the E region are found to be similar to the barometric oscillations with certain phase difference between the two. The solar tidal effects which are particularly large for the F_2 region have also been isolated.

The interpretation of the observed effects is, however, rendered difficult by the fact that the motions of the ions and electrons, under the influence of the geomagnetic field, do not necessarily follow the air motions due to the tides. A theory of the tides in the ionosphere—the so-called electro-dynamic theory—has been developed by Martyn the fundamental basis of which is that though the tidal motions are mainly horizontal, the ions and electrons are constrained to move along the geomagnetic lines of force.

5. *Solar Control: Temperature Rise in the Ionospheric Regions: Wind.*

The temperature distribution in the ionospheric regions above 100 km. is a rising one—the temperature attained being of the order 2000° — 3000° K at 300 km. The origin of this high temperature is the absorption of solar radiation in the extreme ultraviolet. The equilibrium temperature attained is determined by the balance between the absorption on the one hand and radiation and conduction on the other. The absorption dissociates O_2 and ionizes O atoms and N_2 molecules producing energetic O-atoms and electrons. The effective radiators are excited O-atoms, excited by electron impacts. It is probable that during solar flares the temperature rises many times to that of its average value. Quantitative estimates of the temperature variation have been made from measurements of height-luminosity distribution in auroras, of the ionospheric scale heights and of the collision frequency of electrons in the ionospheric regions. The results show that the temperature increases from about 300° K at 100 km. to 2000 to 3000° K at 400 km. It has also been found that the temperature profile undergoes a seasonal variation.

The seasonal temperature variation produces, over and above the existing vertical gradient, meridional temperature gradients (for example, when it is summer in the northern hemisphere and winter in the southern or vice versa). These temperature gradients—vertical and horizontal—establish world wide wind systems, for, there must be transport of heat from a region of high temperature to one of low temperature. The resulting circulation, as in the troposphere, is controlled by the rotation of the earth (deflecting the north-south flow into an east-west flow), by the conservation of angular momentum (the momentum being transported poleward or equatorward according as there is northerly or southerly meridional exchange of air mass) and, by internal friction arising out of viscosity (producing large wind components across the isobars).

Attempts have been made by some authors to picture the wind circulations from observations on the motions of meteor trails, from measurements of movements of ionospheric irregularities, and from theoretical considerations of the temperature gradient. The data are, however, very meagre and the study of the subject is yet in the initial stage.

6. *Solar Control: Sudden Phase Anomaly.*

The sudden increase in ionization which accompanies solar flares manifests itself as radio fade-out only when the flare is intense. A more common effect of solar flares is the lowering of the height of ionization which produces a sudden phase change in the received wave. This phenomenon, called Sudden Phase Anomaly (S. P. A.), is very sensitive to the occurrence of solar flares and is now being studied systematically.

7. *Unsolved Problems.*

Notwithstanding the great advances in our knowledge, the ionosphere is still full of mystery. Some of the unsolved problems are mentioned.

Localised regions of high ionization at low level in the D-region, called sporadic D, have been noted by workers in tropical and sub-tropical latitudes. Little is known about their origin.

Our knowledge of the origin of sporadic E is still far from precise. Ds and Es are known to have maximum ionization round Ceylon and hence are sometimes called 'Ceylon effect'. Nothing is known about the cause of this.

The origin of the fine structure of E region (which had long been believed to vary smoothly with altitude) is still a subject of investigation.

The wavelength of the solar radiation causing the radio fade-out effects is still a debatable one. The same remark applies to the height of the upper atmospheric current system which enhances the Sq type of geomagnetic variation during the fade-out.

To what degree the two effects—the tidal and the rapid altitude decreases of recombination coefficient—contribute to the bifurcation of F_1 into F_1 and F_2 requires further investigations.

The origin of the F_2 region anomalies is still only partially understood. Part of it is undoubtedly due to the tidal air motions of the ions and electrons as influenced by the geomagnetic field and gradient of kinematic viscosity. But it is also highly probable that wind, as caused by the vertical and meridional temperature gradients, contribute to the anomalous behaviour. A full study of the comparative effects of the two causes is very necessary.

The origin of *electrojet*—the intense current belt over the geomagnetic equator—which produces the abnormally large Sq variation at Huancayo (the so-called Huancayo effect)—is ill understood. (The effect has been found to extend to Africa and India). Attempt has been made to explain the production of the electrojet by postulating the existence of a narrow region of high conductivity due to polarization by Hall current. The subject, however, requires further study.

The high value of the recombination coefficient of ions and electrons in the ionospheric region—several orders higher than the theoretical value—is a problem requiring further investigation.

Association between ionospheric conditions on the one hand and barometric conditions at the ground on the other have been reported from time to time. More observations on a world-wide scale on the reality of such associations are needed.

9. Fading in Relation to Ionosphere.

S. R. KHAHGIR, Banaras,

(i) *Random Fading.*

The random variation of signal intensity can be classified under two broad divisions: (i) phase-fading and (ii) intensity fading. Within the ground-wave range, the interference between the ground-wave and the down-coming wave from the ionosphere with a phase-difference varying within wide limits due to random changes in the ionospheric conditions is the origin of phase-fading. The intensity fading may be due to (i) interference between two or more waves, each of which is regularly reflected from a portion of the ionosphere which is not horizontal and which is large compared with a wavelength, or (ii) interference between two or more waves scattered at random from the ionospheric irregularities of extent less than one wavelength, or (iii) interference taking place between several atmospheric waves arriving at the receiving point by slightly different paths.

The work of Ratcliffe and Pawsey with 200–500 metres waves for distances less than 200 km, showed that the intensity fading was mainly due to interference of waves scattered from a series of diffracting centres distributed at random over some area in the ionosphere. They also observed lateral deviations of waves after reflection from the ionosphere. This conclusion was confirmed by Pawsey and later by Khastgir and Ray with medium waves. Sen Gupta and Dutt however observed a departure from the random Rayleigh scattering for longer transmission distances. Such a departure was also observed by Das and Khastgir with short waves and by Tantry and Khastgir with medium waves, even for moderate transmission distances.

Ratcliffe and S. N. Mitra observed a type of random fading with a single pulse at 4 Mc/s received on a circularly polarised aerial. The mathematical analysis of the observed intensity variations has enabled the determination of the continual random motion of the ionospheric irregularities. The effect of a steady motion of the ionosphere has also been shown by S. N. Mitra.

Anomalous variations of the angles of arrival of the down-coming waves have recently been reported by Srivastava and Rajan. These are attributed to the presence of the ordinary and extraordinary waves in the ionosphere.

(ii) *Periodic Types of Fading.*

Appleton & Beynon showed that the interference between the magnetoionic components gave rise to a periodic type of fading during the evening and morning hours, when there was a continuous change of ionospheric ionization.

Periodic fading of a different origin under relatively large ionospheric ionization was reported by Banerjee & Mukherjee, Banerjee & Singh and by Khastgir & Das. This type of periodic fading was attributed by Banerjee and his colleagues to the vertical movement of the ionosphere which caused a continuous change in the path-retardation between the singly and doubly reflected waves from the same layer or between the singly reflected waves from the two layers, yielding thereby intensity maxima and minima. An equivalent representation of the same phenomenon was given by Khastgir in the form of a Doppler-beat theory. This view-point was substantiated by the work of Khastgir & Das with short waves and by that of Tantry & Khastgir with medium waves. Their fading records revealed both the Appleton-Beynon type and the Doppler-beat type of periodic fading. There were also indications of extremely rapid periodicity which could be identified with the 'flutter' phenomenon observed previously, on short waves, by Subba Rao & Somayajulu.

(iii) *Selective Fading.*

An account is given of the work on selective fading observed with amplitude-modulated waves due to the interference of the side-bands.

10. *Irregularities in the Ionosphere.*

S. S. BANERJEE, Banaras.

It has been now realised that the ionosphere seldom behaves as a composite region of plain conducting layers for the purpose of long distance transmission of radio signals. It manifests a number of irregularities in its structure which are of varying nature and affect the propagation of radio waves. It may be mentioned however, that these irregularities are found to be more pronounced as the frequency of transmission is increased; and for long and medium waves, there is more of regularity than the irregularity in the behaviour of the ionosphere.

The above irregularities in the ionosphere have been studied in England by two independent groups of investigators, one in the Cavendish Laboratory, Cambridge, and the other attached to the Radio Research of the Government of Great Britain. The workers in Cambridge have used the pulse and cathode ray oscillographic techniques at vertical incidence for the study of the amplitude variation of the reflected signals from the ionosphere and have attributed the origin of these irregularities to the possible presence of 'winds' in the upper atmosphere. They have also investigated the variations of these irregularities with frequency. The workers in Slough, however, have employed the direction finding technique at oblique and vertical incidence and have shown that there are two types of variations in the angles of arrival of the downcoming waves from the ionosphere. One is the gradual variation of the angle occurring within the order of minutes and the other is the quick variation observed within the order of seconds. From these observations they have concluded that there are 'tilts' in the ionosphere which are responsible for the irregular variations in the intensity of received signals.

In view of the effects of these irregularities in the ionosphere on the propagation of radio waves, particularly during the evening and night hours, which

are the periods of high programme value, we have recently made a number of observations on the intensity variations of short wave radio signals at oblique incidence received from distant broadcasting stations, and also at vertical incidence with low power pulse transmitter. It has been observed that these irregularities may be due to the 'undulations' in the ionosphere which may be composed of convex and concave surfaces rapidly varying their configurations, and under suitable conditions they may produce anomalous variations in the amplitudes of multiply reflected echoes from the ionosphere. It has been further shown that these undulations are generally located in the lower regions of the ionosphere and have movements from east to west directions.

11. Winds in the Ionosphere.

S. N. MITRA, Delhi

In the radio method of exploring winds in the ionosphere short duration pulses were used. The incident radio wave experiences diffractive scattering from local irregularities existing in the ionosphere. A large number of scattered wavelets are therefore originated which combine together to give a resultant wave at the receiver. Now, if the ionospheric irregularities are in motion, the resultant wave will fade. When more than one receivers are used to record simultaneously the fading of the resultant wave, the fading will substantially be the same at the different receiving points provided the distance between any two receivers does not exceed the wavelength of the radio wave used.

In the present paper we outline a method of measuring winds in the ionospheric heights from a study of the fading patterns taken at three receivers placed at the corners of a right angled triangle and separated by distances of the order of 100 metres. A pulsed transmitter operating on a frequency of about 4 Mc/s was used to explore the ionosphere and the transmitter was placed near one of the receivers. The three fading curves at the three receivers were simultaneously photographed. If the ionosphere was non-turbulent and if there is a steady wind blowing the irregularities unchanged in form, the fading pattern at one receiver will be the same at the other but with a time-shift corresponding to the velocity of the wind. We therefore obtain both the magnitude and the direction of the wind-motion from a study of the three fading patterns.

The results of a large number of observations of such winds are described. The most frequent velocity is found to be of the order of 50 m/sec. in a direction towards north-west, but there are clear indications that the velocity varies throughout the day with a semi-diurnal period; the magnitude of the velocity, however, does not alter much. A theoretical explanation is offered for this semi-diurnal variation based on the assumption that the origin of the wind in the ionosphere is due to atmospheric pressure oscillations resulting from solar and lunar gravitational tides. The magnitude of the predicted wind-velocity agrees well with the observed values.

Measurements have also been made in which distant pulsed transmitters were used in conjunction with the same receiving arrangement. In all the experiments care was taken to avoid the misleading conclusions which may be drawn when "polarization fading" occurs due to the interference between two magneto-ionic components present simultaneously in the received wave.

12. An Improved "Pulse" Technique for Exploring the Ionosphere.**B. M. BANERJEE, (Calcutta),**

Experimental investigations on (a) tides in the ionosphere, (b) gradient of ionization and thickness of the E-layer, (c) study of split echoes, (d) scattered reflection in a layer of patchy ionization and reflections from closely spaced multiple layers, demand a much higher precision than what is afforded by the conventional ionosphere sounding apparatus. The conventional apparatus uses pulses of 100-200 μ sec. duration and a single line time base usually producing a sweep of 20 milliseconds, which limits the height measuring accuracy to the order of 10 km. A satisfactory investigation of the above-mentioned phenomenon requires an accuracy 1 km. The height measuring accuracy could be improved by using pulses of shorter duration pulse occupies a wider band and this reduces the accuracy of the frequency determination. This is a somewhat inherent defect of the conventional method of sounding.

An apparatus has been developed that utilises a triggered raster time base that produces twelve lines, each corresponding to 50 km. or 333 μ secs. Attempt was made to reduce the pulse duration to three micro-seconds. The transmitter utilises a pulse which can produce pulses of 2-20 μ sec. duration. The oscillator pulse is, however, broadened to 8-30 μ secs. because oscillations once excited, take a time of that order of magnitude to die out. The shorter duration demands a correspondingly higher peak power, to keep the energy per pulse packet the same as before. The transmitter is therefore designed to be able to work with a peak input of 50-100 kw. The receiver at present used possesses a 3 db. bandwidth of 90 kc/s and produces pulses of base width of about 15-20 μ secs. The pulses as observed on the receiver oscilloscope have a triangular shape with a very well defined tip. It is therefore easy to measure heights with an accuracy of 1 km., in spite of a base width of 4 to 8 kms. With the short pulses the transmitter is capable of producing it would be advantageous to use a receiver of 200 kc/s bandwidth which would produce a proportionate improvement in the accuracy of height measurement.

The accuracy of frequency measurement is retained because the receiver incorporates a frequency responsive output channel (non-responsive to amplitude variations such as are used in a frequency modulation receiver) which produces an up and down Λ shaped pulse on the oscilloscope. The center frequency corresponds to the middle-point (dot marked) of this output pulse, so that the time delay for the center frequency could be accurately measured. The time delay of the adjacent frequencies can also be measured from the corresponding points. The limitations in the accuracy of the frequency measurement of the conventional method of sounding, which keeps an uncertainty as to the frequency which corresponds to the height measured from the distance between the tips of the transmitted and reflected pulses, are therefore not encountered.

The apparatus will be put into a regular operating schedule for investigation of tides and the E region gradient. The high resolution of the apparatus allows a very beautiful observation of magneto-ionic splitting and of the behaviour of the split echoes. This also may form the subject matter of a careful and critical study.

13. Propagation of Radio Waves Through Ionosphere.**B. K. BANERJEE, Delhi.**

From the standpoint of the propagation of c.m. waves, the ionosphere is a medium which is characterised by cyclotonic anisotropy, absorption and a conti-

nuously changing in homogeneity. In such a medium the propagation of an e.m. wave, specified by the field vectors ($\vec{E}$ $\vec{K}$ & $\vec{D}$) is governed by the equations,

$$\nabla \times \vec{K} = \frac{1}{c} \frac{\partial \vec{D}}{\partial t} ; \nabla \times \vec{E} = -\frac{1}{c} \frac{\partial \vec{K}}{\partial t} ; \vec{D} = \vec{E} + 4\pi N e \vec{S} \quad (\text{Maxwell equations})$$

$$\frac{d^2 \vec{S}}{dt^2} + \nu \frac{d \vec{S}}{dt} + \frac{e}{m_0 c} \left[\vec{H}_0 \times \frac{d \vec{S}}{dt} \right] - \frac{e}{m_0} \vec{E} \quad (\text{Lorentz' equations})$$

where e , m_0 , $\vec{S}$, ν and N are the charge, mass, displacement, collision frequency and concentration of electrons and $\vec{H}_0$ is the steady geomagnetic field, For the vertical propagation of a plane wave of pulsance p the equation of propagation for the electric vector is

$$\frac{d^2 \vec{E}}{dz^2} + \frac{p^2}{c^2} \epsilon \cdot \vec{E} = 0$$

where the elements of the tensor ϵ are

$$\epsilon_{11} = 1 - \gamma \frac{\beta^2 - \gamma \beta - \omega^2}{c^1}, \quad \epsilon_{12} = -\epsilon_{21} = \frac{\gamma(\beta - \gamma) \omega_z}{c^1}, \quad \epsilon_{22} = 1 - \gamma \frac{\beta^2 - \gamma \beta}{c^1}$$

$$\text{with } c^1 = \beta (\beta^2 - \omega^2) - \gamma (\beta^2 - \omega_z^2), \quad \gamma = \frac{p_0^2}{p^2} \left[\frac{4\pi N e^2}{m_0 p^2} \right],$$

$$\beta = 1 - i\nu/p = 1 - i\delta, \quad \omega = \frac{e \vec{H}_0}{m_0 c_p}$$

and the xz plane has been taken as the magnetic meridian with Z as the vertical axis. Introducing the new dependent variables

$$V = (E_x + i\rho E_y) / \sqrt{1 + \rho^2}, \quad W = (E_x - iE_y / \rho) / \sqrt{1 + 1/\rho^2}$$

the equations of propagation of the two differently polarised wave become

$$\ddot{V} + (q_0^2 - \dot{\phi}^2) V = 2\dot{\phi} \dot{W} + \phi \ddot{W}$$

$$\ddot{W} + (q_c^2 - \dot{\phi}^2) W = -2\dot{\phi} \dot{V} - \phi \ddot{V}$$

where $\dot{V}, \dot{W} \dots = \frac{dV}{du}, \frac{dW}{du} \dots$ etc. $u = p_z/c, q_0^2, q_c^2$ the

squares of complex refractive indices of Magneto-ionic theory, $\rho = G - \sqrt{1+G^2}$,

$$G = \frac{\delta_c}{\gamma - \beta}, \delta_c \text{ the magnetic damping factor } \frac{w_x^2}{2w_z} \text{ and } \dot{\phi} = \frac{\dot{\rho}}{1+\rho^2}$$

Assuming a Chapman or parabolic type of ion barrier and exponential variation of collision frequency, it can be shown that $\dot{\phi}$ is negligibly small all throughout the layer except at the point $\gamma = 1$, i. e., $p^2 = p_0^2$ where it attains its maximum value $|\dot{\phi}|_{\max}$ which varies from 10^{-4} at Huancayo to 10^{-1} at Clyde River for E layer ($\nu_0 = 10^5$, half width = 10 kms) and from 10^{-5} at Huancayo to 10^{-2} at Clyde River for F layer ($\nu_0 = 10^3$, half-width = 50 km). Hence we can divide this propagation into two different classes, viz.

(A) Orthodox propagation given by the approximate equations,

$$\frac{d^2 V}{du^2} + q_0^2 V = 0, \frac{d^2 W}{du^2} + q_c^2 W = 0$$

holds practically through the entire ion layer and over the entire globe excluding a small polar belt of about 10° . In this case the solutions are approximately given by

$$(\text{O-wave}) \quad V = \frac{E_x + i\rho E_y}{\sqrt{1+\rho^2}} \simeq A_c i p t - \frac{i p}{c} \int q_0 \left[\sqrt{1 - q_0^2 / 4 q_0^4} - \dot{q}_0 / 2 q_0^2 \right] dz$$

$$+ B_c i p t + \frac{i p}{c} \int q_c \left[\sqrt{1 - q_0^2 / 4 q_0^4} + \dot{q}_0 / 2 q_0^2 \right] dz$$

$$(\text{e-wave}) \quad W = \frac{E_x - i\rho E_y}{\sqrt{1+\rho^2}} \simeq C_c i p t - \frac{i p}{c} \int q_c \left[\sqrt{1 - q_c^2 / 4 q_c^4} - \dot{q}_c / 2 q_c^2 \right] dz$$

$$+ D_c i p t + \frac{i p}{c} \int q_c \left[\sqrt{1 - q_c^2 / 4 q_c^4} + \dot{q}_c / 2 q_c^2 \right] dz$$

From these solutions we can calculate the observables like path or phase retardation in the layer, the reflection coefficient and the polarisation ratio.

(B) Unorthodox propagation :

In this case $\dot{\phi}$ is not negligible and exact wave equations cannot be set up or solved. However, we can study the nature of propagation in this case

by studying how ϕ varies in a ξ η plane, where $\xi = \partial/\partial_c$, $\eta = (1 - \gamma/\partial_c)$ because this plane attains its maximum value at $\xi = 1$, $\eta = 0$. Such a trajectory of the wave can be plotted for any particular station and the observable peculiarities may be inferred. For stations where magnetic damping is large compared to collisional damping, region of peculiarities is reached for very large wavelengths, while for high latitude stations, peculiarities are observed near critical frequency.

14. Ionospheric Prediction.

S. S. BARAL, Calcutta,

For practical maintenance of radio service between two distant points it is very necessary to know well in advance, the Maximum Usable Frequency (MUF) between the two points. Such advance knowledge, in its turn, is only possible when the ionospheric characteristics—critical frequency, lowest height h , and semi-thickness of the reflecting layer—over the mid-point of the communicating stations are known correspondingly in advance. Hence has arisen the necessity of ionospheric predictions. In the present note some recent advances in the prediction technique, as also some contributions to the same by the author will be briefly described.

The problem of ionospheric prediction consists of two parts : (1) Prediction of vertical incidence critical frequencies and MUF factors (which are functions of and transmission distance D) for a station for which past ionospheric records are available and (2) extension of this prediction for stations in other latitudes for which past records may not be available.

For the E and F1 regions both the predictions are comparatively simple because the laws of variations of the characteristics of these regions are more or less accurately known. The predictions for the stations for which past records are available are made from the seasonal and the solar-cycle trends of such records. For extension of the predictions to other latitudes, the simple $\cos$ law of variation of the critical frequencies is assumed. The predictions thus made are reasonably accurate and can be done years in advance if sufficient past data are available.

The F2 region predictions are more difficult and also much less accurate as there are no simple laws of variation of the characteristics of this region. The predictor has thus to take into account all the observed peculiarities in the variation of the region, and has, ultimately, to have recourse to extrapolation to obtain the expected future characteristics. But even this extrapolation, with the present state of our knowledge, cannot be extended beyond five months. For extrapolation in latitude, the geomagnetic, rather than the geographic, latitude has to be taken as the latitude of reference. This is because the F2 region is known to be under strong geomagnetic control. As the diurnal variation is found to be approximately the same only over limited ranges of longitude (on the same geomagnetic latitude) it has been customary to make predictions in sections. The following ranges of longitude have been adopted : 50°E-170°E (East zone), 130°W-10°W (West zone) and 10°W-50°E and 170°E-130°W (Intermediate zones). There has, however, been a recent proposal to redistribute these longitude zones on the ground that the F2 region variation in Africa and Europe correspond closely

to those in Asia for the same geomagnetic latitude. The new divisions proposed are 0-160°E, East zone, 40°W-100°W, West zone, and the rest the Intermediate zones,

However, the F2 region predictions, made as above, do not conform to expectations even ignoring departures due to other causes (*vide infra*). For example, consider stations situated on the great circle joining the intersecting points of the geographic and geomagnetic latitudes. Four stations two in north and two in the south situated at equal distances north and south of equator—should be expected to have identical reion F2 characteristics. This however is not found to be the case.

Of the other difficulties of making accurate F2 predictions mention may be made of the following. It has been found that though the mid-day critical frequency is under geomagnetic control, the diurnal minimum (presunrise) is not so. Its world variation corresponds rather to the geographical than to the geomagnetic latitude. Again, the day to day variations are quite large and unpredictable. As such, the predictions which relate only to the monthly mean values, often show large departures from the actual values. These departures are greatest during the equinoxes. During the winter months they are small.

Amongst the future extensions of the prediction programme for the use of the radio communication service, the following may be mentioned :

It has been observed that communication is sometimes established at frequencies much higher than those predicted on the assumption of E or F2 layer refraction. This is caused by the intervention of the abnormal or sporadic E layer ionization, which sometimes reflects quite high frequencies, as 10 Mc, at vertical incidence. As such for propagation over a distance of 2,000 km. by oblique incidence the sporadic E layer may reflect frequencies as high as 60 Mc. However, one must wait for more data regarding the occurrence and intensity of Es reflection before attempting the predictions. The predictions for the E region are made at present only for daylight transmission. No night predictions are made on account of the paucity of recorded data. Such night predictions are, however, important because of specialized broadcasts, e.g. the Loran (long-range radio navigation) which work on frequencies in the 2 Mc. band.

Predictions should be made regarding another ionospheric characteristic viz. absorption. At present, this is being made only for the Slough station of the Radio Research Board, England, because this stations possesses absorption data so that predictions of this useful ionospheric characteristic be possible for stations in other latitudes.

Section IV. : CHEMISTRY.

1. A New Method for Analysis of Xanthates.

K. K. MAJUMDAR, Dhanbad.

A new method for analysis of xanthates in flotation pulps containing cyanide, sulphide, sulphite, sulphate etc. has been developed, which is very rapid

and accurate. It depends on the fact that lead ions form insoluble salts with xanthates, which are soluble in organic solvents like ether, benzene etc. but the insoluble lead salts of other inorganic ions as mentioned above are not soluble in organic solvents. Therefore, from a suspension of mixed lead salts, the organic solvent will extract only lead xanthates and this soln. can be separated from bulk in a separating funnel. The organic solvent on evaporation will yield crystals of lead xanthates, which can be estimated by direct weighing and xanthate equivalent can be calculated.

2. A Study of the Various types of Oil Cakes Produced in Uttar Pradesh.

OM PRAKASH, T. R. SHARMA and AMANULLA KHAN, Uttar Pradesh, Kanpur.

The work was taken up at the Harcourt Butler Technological Institute, Kanpur in order to determine the chemical composition of oil cakes in U. P. with a view to study their Scientific utilisation. A large number of different oil cakes have been collected through the courtesy of oil mills in different centres of U. P. They have been analysed for their chemical composition. Ash contents in selected cases have also been analysed for their contents of phosphate, potassium and sodium. The work is of importance as no work of this nature appears to have been so far carried out in India. Important conclusions have been drawn.

3. Technical Uses of Argemone Oil

OM PRAKASH, T. R. SHARMA and AMANULLA KHAN, Kanpur.

The work was undertaken to divert the use of argemone seed and its oil into legitimate commercial channels so as to relieve the problem created by the misuse of argemone seed in the adulteration of mustard seed.

The results found are :—

Argemone oil can be mixed with linseed oil upto 20 % in the preparation of boiled oils and varnish. Argemone oil can also be dehydrated and the dehydrated oil can be mixed with linseed oil upto 40 %. In the preparation of soap, argemone oil can be used with other oils upto 33 %. Thickened oil prepared by blowing air into argemone oil may be used for preparing blended lubricants but it is necessary to carry out practical tests over long periods to test its suitability. Thickened argemone oil can be used as lithographic varnish along with linseed stand oil in the manufacture of printing inks. Argemone oil can be used as burning oil like rape oil. The refined argemone oil appears to be suitable for use in hair oils unless it is medically found injurious for the skin and hair. Argemone oil has not been found to be suitable in the manufacture of phenyle.

Section VI. : BOTANY.

1. The Eco-anatomy of the roots of some plants of Western India.

J. P. CORREA, Delhi,

The plants described Specialised underground storage organs.

(i) *Evergreen Phanerophytes :*

Vitis repanda Wight and Arn.

Vitis trifolia Linn.

(ii) *Deciduous Phanerophytes :*

Pueraria tuberosa DC.

Erect hemicryptophytes :

With specialised underground storage organs,

Leea crispa Linn.

Scandent hemicryptophytes

Vitis latifolia Roxb.

Cryptophytes :

(iii) *Cryptophytes :*

With perennial underground root tubers.

Leea macrophylla Roxb.

With tubers lasting one unfavourable season.

Curcuma pseudomontana Grah.

A complete morphological and anatomical study has been made of the roots with special reference to the modifications in the mode of activity of the cambia resulting in production of masses of unlignified parenchyma, failure in lignification of xylem cells etc. and other structural details.

A discussion is given of the correlation of the structural modifications in relation to environmental factors. The root habits are graded according to the life forms recognised by Raunkiaer. It has been observed that there is an evolutionary trend based on anatomy grading from the primitive Phanerophytic type to the advanced Cryptophyte.

2. On the Distribution of Algae in a Group of Six Small Ponds.

C. B. RAO, Madras.

This paper deals with an attempt at correlating the distribution of algae in a group of six small ponds with chemical factors like pH , Bicarbonate, Total dissolved solids, Oxygen, Carbon dioxide, Silica, Nitrate, Phosphate, Iron, Oxidisable organic matter, Free & saline ammonia, Albuminoid ammonia and C/N ratio. Observations were made on three of the six ponds for twenty four months and on the other three for twelve months. Water of each one of these ponds was analysed once a month; the algae inhabiting each pond were estimated once a month.

From the data, the following ideas appear relevant: Green algae (Volvocales, Chlorococcales and Desmids) were poorly represented in ponds with

a high concentration of Albuminoid ammonia and a low quantity of Oxygen. Blue-green algae were plentiful in ponds having high Oxidisable organic matter and low O_2 concentrations, besides pH around neutrality. Three of the six ponds were alkaline and the others acidic. Diatoms were in larger numbers in the alkaline ponds than in the acidic ones. Flagellates (Volvocales, Euglenineae, Chrysophyceae, Cryptophyceae and Dinophyceae) were more numerous in the acidic ponds than in the alkaline ones. Two of the acidic ponds having a higher C/N ratio and a higher concentration of total Iron harboured a higher percentage of Euglenineae.

3. Contribution to the Life history of *Scilla indicæ* Baker.

D. A. GOVINDAPPA and A SHERIFF, Bangalore.

The development of the male and female gametophytes in *Scilla indicæ* Baker has been studied.

The wall of the anther is made up of three layers of cells external to the tapetum. These are the epidermis, the endothecium and the middle layer. The endothecium acquires fibrous thickenings and the middle layer disorganises in later stages. The tapetum consists of binucleate cells.

Quadripartition of the microspore mother cells takes place by cell-plate formation and the microspores are arranged in an iso-bilateral manner. The mature pollen grain is monocolpate with an elongated generative cell and a more or less spherical tube nucleus. The exine exhibits warty sculpturing.

The ovules are bitegmic and anatropous. The development of the female gametophyte follows the *Polygonum* type, a unique feature which is not observed in the other species of this genus where it is typically bisporic and belongs to the *Allium* type. The synergids are large and beaked and exhibit the "filiform apparatus." The antipodals organise themselves as definite cells.

A fully developed embryo sac is very much dilated at the chalazal region.

4. Crossability Studies in the South American diploid species of the tuber-bearing Solanums.

PUSHKARNATH, Patna.

Results of selfing and crossability tests carried out at the Potato Breeding Sub-station, Simla, are presented with respect to several wild and cultivated tuber-bearing species belonging to genus *Solanum*.

Out of the thirteen series, in which the genus *Solanum* is divided, nine have been studied and the results are briefly summarized below :

1. *Series V : Cardiophylla* : In this series the only diploid *S. lanciforme* is highly self-incompatible. Crosses between different clones of this species are, however, fully compatible. It crosses with no other species belonging to any other series.

2. *Series VI : Pinnatisecta* : *S. Jamesii* is the only diploid represented in this series. All the clones and varieties are highly self-incompatible. Cross-incompatibility between various clones is widespread. In crosses with species involv

ing series *Commersonia* some berries may be formed but they invariably contain infertile or no seed. Similar results have been obtained when certain other species belonging to the series *Tuberosa* are crossed with *S. Jamesii*.

3. *Series VII : Commersonia* : Selfing results have shown that all clones of *S. saltense*, *S. subtilius*, *S. jujuyense*, *S. tarijense* and *S. caldashi* are highly self-incompatible. Most of the clones of *S. chacoense* are self-compatible but self incompatible clones are also met with within this species. *S. garcae*, *S. gibberulosum*, *S. schickii* and *S. parodii* show a low degree of self-compatibility.

Within the limits of a species, crossability tests between different clones and varieties have shown almost an universal cross-compatible while others are cross-incompatible,

Different species belonging to this series are fully cross-compatible. Cross-compatibility relationships with other diploids have shown that the group of species is generally cross-compatible only with diploids belonging to the series *Tuberosa*.

4. *Series VIII : Acaulia* : No diploids are met within this series. The two tetraploid species *S. acaule* and *S. depexum* are highly cross-and self-compatible.

5. *Series IX : Demissia* : The only diploid *S. verrucosum* is highly self-compatible. Crosses between various clones of this species are also cross-compatible.

7. *Series XI : Longipedicellata* : No diploids are met with, all species are tetraploids and are highly self-and cross-compatible.

8. *Series XII : Polyadenia* : The only diploid *S. polyadenium* is highly self-compatible. All the clones of this species freely cross with each other. It is difficult to cross with diploids belonging to any other series.

9. *Series XIII : Tuberosa* : *S. aracc-papa*, *S. rybinii*, *S. simplicifolium*, *S. phureja*, *S. stenotomum* (certain varieties), *S. berthaultii*, *S. anomolocalyx*, *S. yabari*, and *S. lapaxense* were found to be self-incompatible, *S. calcense* is, however, self-compatible.

Different varieties and clones of *S. rybinii* may be cross-compatible or cross-incompatible.

Crossability tests have shown that *S. aracc-papa* is cross-compatible with *S. caldasii*, *S. chacoense* and *S. subtilius* of the series *Commersonia* only when used as male parent. When used as male with *S. rybinii* it is also cross compatible.

S. rybinii is cross-compatible with species belonging to *Commersonia* series and also with *S. simplicifolium* of the series *Tuberosa*.

Genetic basis of self-and cross-incompatibility : Within a related group self and cross-incompatibility relationships are controlled by one major gene. Several alleles usually operate and these, in various permutations and combinations, regulate the expression of self-and cross-incompatibility.

Evidence derived from several sources leads to the conclusion that there are, in diploid *Solanums*, several independent major sterility genes (of their four are mentioned). They are independent and unrelated. They are the major limiting factors to free crossability between various groups of diploids.

On the basis of the crossability results the possible phylogenetic relationship between various taxonomic groups is indicated.

5. **Cytological Studies of pollen tube growth in reciprocal crosses between *Corchorus capsularis* & *Corchorus olitorius*.**

K. V. SRINATH and B. C. KUNDU, Barackpore,

One of the outstanding problems in the genetics of Jute is the strong incompatibility between the two cultivated species, *Corchorus capsularis* and *Corchorus olitorius*. In an attempt to find the basic cause of this incompatibility, some cytological observations were made on pollen tube growth. Controlled pollinations were made for reciprocal matings of diploid *C. olitorius* and diploid *C. capsularis*. The style of *C. olitorius* is longer (mean-C. G. 2.80 mm) than that of *C. capsularis*. There is in addition a marked variation in length from short to long styles. In this respect R. 26 (*C. olitorius*) is intermediate between D 154 (*C. capsularis*) and C. G.

Pollinations were made between 9 and 10 in the mornings and the flowers fixed at ten intervals in acetic alcohol. They were subsequently treated in boiling lactophenol, squashed and stained with acid fuchsin. The main conclusions reached so far are as follows :

- (1) The rate of growth of the pollen tube is the same in self-and cross-matings with *C. olitorius* as 0.
- (2) The rate of growth of the pollen tubes is the same in self-and cross-matings with *C. capsularis* as 0.
- (3) There is a slight difference between the reciprocal matings in regard to the commencement of germination. Germination of the pollen is late in *C. capsularis* but the tubes reach the base of the style ten minutes earlier.
- (4) Incompatibility is not due to any retardation in the growth of the pollen tubes.
- (5) The shortness of the style offers no advantage in overcoming the cross-incompatibility.

6. **Notes on Some Species of *Cercospora* from Mysore.**

H. C. GOVINDU, Bangalore.

Examination of various species of *Cercospora* collected by the author in Mysore revealed the occurrence of *Cercospora trichophila* Stevens on *Salanum verbascifolium* L. and *C. melanotes* Syd. on *Melochia* sp. both of them being new records for India. On the leaves of *Tridax procumbens* L. an undescribed species of *Cercospora* was collected and studied. The fungus incited the formation of greyish-white circular spots. The conidiophores were 42.2—77.4 long, unbranched, not developed from any stroma, 1-3-septate. Conidia were acicular, hyaline, 1-4-septate, truncate at the base and acute at the apex. The name *Cercospora Tridaxis-procumbentis* Govindu and Thirumalachar is proposed for its accommodation.

7. **Observations on the floral biology of sweet potato.**

D. CHATTERJEE and S. C. NAGBISWAS, New Delhi.

Sweet potato being propagated vegetatively, seldom produces flowers and

when it does, the flowers do not mature to produce seeds. Out of the 50 different types of Sweet potato grown in Delhi, only 4 types produced flowers. Detailed study of the floral biology of these types, specially of G. T. 6, was undertaken. It was found that there are two peak periods of flower opening i.e., (1) between 4 A.M. to 6 A.M. and (2) between 12 A.M. to 2 P.M. Although the pollen fertility is very high i.e., 76.5 to 100 percent, from a study of growth of pollen tube, artificial pollination etc. no fruit setting was possible. This shows that the plants are self-sterile. Studies on photoperiodism of sweet potato and opportunities of cross-pollination might give favourable data which could be utilised for flowering and fruit setting. These may ultimately help in improving the sweet potato crop by breeding which is not possible at present.

METABOLIC ASPECTS OF GROWTH

8. Effect of Manuring and Nutrients on Photosynthesis.

BHOLA NATH SINGH, Lucknow.

External factors such as CO_2 , water, light intensity, atmospheric humidity and elements that enter plant, greatly governed the process by their concentration and combination to determine the intensity of carbon assimilation. The factors concerned in photosynthesis in the tropics and sub-tropics are somewhat different in their magnitude and combination as adaptation to changed climatic conditions. This needs their correct appreciation and of the nature, amount, and significance of photosynthesis under the varied conditions of soil and season. Photosynthesis responded differently to different manures, and played dominant role in determining the unidirectional trend of both respiration and growth. Application of nitrogen to wheat and paddy as organic and inorganic manures (castor cake and sulphate of ammonia) augmented photosynthetic efficiency and chlorophyll values. Castor cake proved significantly more efficient in markedly increasing rates of intake of CO_2 in both real and apparent values of photosynthesis; at the milky stage the increase was of the lesser magnitude. Sulphate of ammonia increased both real and apparent assimilation at pre-flowering, but at milky stage, reverse was true.

9. Effect of Size of Nitrogen Dressings on Photosynthesis and Respiration in Wheat.

BHOLA NATH SINGH and PATESHWARI PRASAD GUPTA, Lucknow.

Testing effect of higher concentrations of sulphate of ammonia on flag leaf of wheat, it was found that photosynthesis at 50 and 100 lb N/acre remained almost the same; further additions of nitrogen upto 500 lb consistently depressed photosynthetic rate. Apparent assimilation was higher than control at 50 lb, the rest of the doses gave lower values. The optimum concentration for assimilation was between 50 and 100 lb. At flowering, maximum respiration was recorded at 150 lb; at the earlier stage (15th week), application of nitrogen beyond 50 lb resulted in the depression of respiration rate.

10. Effect of Phosphorus, Calcium and Sulphur in Varying Doses and Combinations on Photosynthetic Activity of Wheat.

BHOLA NATH SINGH and PATESHWARI PRASAD GUPTA, Lucknow.

Rates and dates (D) of application of nitrogen showed marked effect on photosynthesis. At pre-flowering, application of 30 lb. nitrogen, all at planting, proved best: 30 D₁ accelerated both real and apparent assimilation remarkably, but reduced respiration. The order of response to rates and dates of application in decreasing succession may be expressed as: *real assimilation* 30D₁, 0, 30D₂, 60D₁, 60D₂, *apparent assimilation*—30D₁, 60D₁, 30D₂, 0, 60D₂. At pre-flowering, P₁ was most efficient in enhancing real assimilation; apparent assimilation was highest with Ca₂; P₁ was better than P₂. At flowering, P and Ca, applied singly or in combination, increased photosynthetic efficiency of flag leaf: at later stages, P increased assimilation. At pre-flowering no treatment proved better than P or Ca or their combinations. Of the combinations, P₂C₂ gave highest real assimilation and P₂C₁ maximum apparent assimilation. Studying the effect of levels of sulphur, S₁₀ proved most effective in elevating both real and apparent assimilation. Between the levels of S, real assimilation decreased in the following order: S₁₀, 0, S₃₀, S₂₀, S₄₀, S₅₀, and apparent assimilation increased as S₅₀, S₄₀, S₂₀, S₃₀, 0, S₁₀.

11. The Response of the Respiratory System to Age and Developmental Stages of Crops.

BHOLA NATH SINGH, Lucknow.

Respiration is most vital to growth and is of great agricultural value. The plant grows: for this, it needs energy: this is supplied through the oxidation of materials within the protoplasm of the plant. Experiments conducted to trace march of respiration in crop plants and of their parts at successive stages of development, showed that with age, the respiratory activity followed assimilation, growth rates exhibiting greatest activity at stages when photosynthesis was maximum, and minimum, when it was lowest: this was true for each of plant parts like root, stem, leaf, floral organs, and the developing seeds. The entire activity of respiration was divisible into two well defined stages: first, lasting upto pre-flowering, in the starting and culmination of vegetative growth; the second overlapped the initiation of reproductive phase, wherein the grand period of growth and of respiration synchronised. Water content of tissues was common internal factor governing respiration, growth, and assimilation, in that all showed a parallel run during the life of the plant and its organs. Respiratory activity of different tillers in a stool of wheat decreased with age; respiration of leaves declined in succession from top to bottom at any stage; young leaves or roots had highest respiratory activity, the mature and old ones following in succession. Young tillers similarly respired more than the mature or the old ones.

12. The Relation Between Respiration and Nutrient Supply in Crop Plants.

BHOLA NATH SINGH, and BAL GOVIND DABARAL, Lucknow.

Castor cake (CC) and sulphate of ammonia (S/A), applied on equal nitrogen basis, influenced respiration of roots and leaves differently. S/A gave

higher respiration in roots, followed by cake and no-manure; in leaf, no-manure gave maximum value and cake minimum. Date of application of S/A was as significant as its rate. Root respiration was highest with 60 lb N/acre, all applied with sowing; piecemeal application reduced respiration. Leaf respiration was highest at 30 lb., followed by 60 lb. (in piecemeal), no-manure, and 60 lb. (wholemeal at planting). At juvenile stage, doses of N increased respiration of root and leaf: increasing doses upto 100 lb. caused maximum respiration in roots, followed by N_{150} , N_{200} , N_{50} and N_0 in decreasing succession. Leaf respiration was maximum with N_{50} and decreased consistently with increasing doses. Sulphur increased respiration of root and leaf alike: S_{30} gave highest respiration and S_0 lowest. Phosphorus increased leaf respiration when applied with calcium. The stimulating effect of P was shown in an earlier study as a promoter of the oxidative system in the mechanism of respiration. Root respiration was brought down by P; Ca proved better than P. The association of Ca with P in increasing respiration is further proof of the linked activity of the two elements in plant metabolism.

13. The Relation of Respiration to Photosynthesis, Chlorophyll and Growth.

BHOLA NATH SINGH, Lucknow.

There was observed upto a certain stage, a close relationship of photosynthesis with the chlorophyll components, respiration rate and the magnitude of growth, suggesting fundamental linkage. Photosynthesis showed direct increase with increase in chlorophyll for all treatments except for P_2Ca_2 ; with age, chlorophyll decreased. Photosynthesis of 'type leaves' or of the entire area exposed by the plant, consisting of leaves of varying age relation, exhibited a grand period to run parallel with respiration and growth. Highest photosynthesis was measured at pre-flowing when there was rapid growth in the plant and its composing parts, in the leaf area and NAR: to meet the increased demand of both photosynthesis and growth on the energy that was needed, respiratory activity was at its peak simultaneously. It is at the time of highest activity of photosynthesis that greatest need existed for nutrients and water. With respiration, photosynthesis also was high at tillering, then at preflowering, and subsequently declined with age; the larger demand on assimilation was obviously met by larger assimilating leaf surface wherein the intensity though slackened, was made up by the larger leaf surface of the older leaf types: the flag leaf at this stage took upon itself the function of carbon assimilation and contributed to almost 1/20th of photosynthates to that supplied through translocation for seed formation. With decline of associated physiological activities, photosynthesis also declined, though earlier, with age; hydration of tissues and permeability were main factors in inducing old age.

CROP PRODUCTION IN RELATION TO DAY-LENGTH.

14. Effect of Day-Length on Growth, Development and Yield of Paddy.

BHOLA NATH SINGH, and SHRI RAM JALOTE, Lucknow.

In any study directed to fix optimal day-length for growth and yield, it is obvious that plants must be subjected to varying lengths of day ranging from

continuous illumination of 24 hr. down to complete darkness when the time period is reduced to nullity; this has to be done to determine the upper, lower (critical photo-periods) and optimum limits of growth, if, indeed, such limits actually exist. Experiments undertaken to investigate growth behaviour to alterations in day-length (6, 10, normal day-length, 18, and 24 hr) showed that with increase in day-length, shoot elongation, tillering, number of leaves, length of leaf, fresh and dry matter, length of root, number and weight of grains per ear and yield increased upto 18 hr; further increase to 24 hr was without any economic gain, although the treated plants stood still significantly superior to control; 18 hr photo-period increased yield by 72 %. Optimum photo-period for early paddy lay near 18 hr: early paddy is a rainy season crop when light may be partially limiting; with decreasing photo-period growth and dry matter elaboration were progressively limited to the reducing of the life-cycle and the reproductive phase. For 10-hour day, plants definitely grew to sub-normal size and fertilization and grain development were none too worse; those for 6 hr failed to achieve fertilization, with no grain fully developed.

15. Effect of Day-Length on Growth, Development, Tuberisation and Yield of Potato.

BHOLA NATH SINGH and SHRI RAM JALOTE, Lucknow.

With a view to determine optimum photo-period for the maximum production of potato tubers, potato plants grown in pots were subjected to varying photoperiods ranging from partial darkness to 20 hr by supplementing artificial light. Growth of potato plant, foliage formation and tuberisation all kept on increasing with increase in day length leading to maximum length of vine, number of leaves, fresh and dry matter accumulation in both shoot and root and yield of potato with larger tubers, though less in number, in plants subjected to longest day length of 20 hr. The increase in tuber yield due to 20-hour day length was of the order of 48 per cent over control. There, thus, appears to be an upper limit to the amount of light which a potato plant can utilize and above which it makes no additional growth. Under sub-normal durations, it failed to grow normally: development of plant parts as also tuberisation and dry matter production were each retarded. The supra-normal durations induced early flowering though delayed maturity.

16. Effect of Day Length on Growth, Yield and Nodulation in *Phaseolus radiatus*.

BHOLA NATH SINGH and SHRI RAM JALOTE, Lucknow.

The importance of day length as an ecological factor in growth and development of crop species grown in different seasons and at different latitudes has been greatly stressed in recent years. The biochemic constitution of the plants as to sugary, starchy, proteinaceous and the special micro-climate to which the crop plants are subjected owing to cultural conditions are discovered to have profound influence on both growth and yield: the effect of photoperiods on modulation in the legumes has not yet received adequate attention. With increase in day-length beyond natural hours, height, fresh and dry matter of both root and shoot, and nodulation (number, size and weight) displayed consistent increase upto 16 hr; further increase gave no significant response in fresh and dry matter elaboration of shoot, though significantly so for height and fresh and dry matter

in roots. Grain yield was highest in control. Both decreases and increases beyond normal sun-shine depressed yield. It thus appears that sub-normal and supra-normal photoperiods supported 'growth' but retarded 'development.' Numerical strength of nodules along with their size and weight increased upto 16 hr. beyond which these fell precipitately: longer days may thus accelerate the activity of the *Rhizobium* to nitrogen fixation and soil fertility though not yield in this legume.

BIOLOGICAL EFFECTS OF RADIATION IN CROP PRODUCTION

17. The Controlling Influence of Ultra-violet and Infra-red Rays on Growth and Yield of Paddy.

BHOLA NATH SINGH and SHRI RAM JALOTE, Lucknow.

Soaked paddy seeds (T 136) exposed to varying doses of u.v. and i.r. from the source at 60 cm distance for 0, 5, 10, and 15 min. were grown in large pots with adequate soil-manure mixture. Paddy behaved differently under different radiations and durations. Height, tillering, leaf number, length of leaf, root length, fresh and dry matter elaboration of plant parts, tillering, earing, number and weight of grain and yield showed significant linear increase with duration of u.v. were maximum for 20 min., grain yield being 71 % higher. Infra-red retarded germination: germinated seeds showed high growth potential and vigour. There was increase in tillering, leaf number, leaf length, fresh and dry matter, root elongation, ears, number and weight of grains and yield of grain: increasing doses depressed height consistently; 5 min. proved optimum and produced maximum growth and yield (245 % higher than control) and proved best; further increase in duration failed to obtain proportionate increase in yield, but was still superior to control; 5 and 10 min. showed little response, although 5 min. proved superior to 10 min. and control; the slackening of growth by 10 min. exposure can not at present be explained. The method gives promise of supplying irradiated seeds to cultivators for improving yields.

18. Crop Nutrition Experiments :/- Effect of Nitrogen, Phosphorus and Boron on *Phaseolus radiatus*.

BHOLA NATH SINGH and SHRI RAM JALOTE, Lucknow.

Phaseolus radiatus (Moong Type 1) responded remarkably to nitrogen alone when applied in the form of sulphate of ammonia @ 40 lb. N/acre and significantly increased height, fresh and dry matter production, nodulation, yield and number of grains. Phosphorus alone stood next in response when applied as superphosphate @ 50 lb. P_2O_5 and proved beneficial in all respects though significantly for height, nodulation, number and yield of grains. Boron applied singly as borax @ 5 lb. B_2O_3 retarded fresh and dry matter and nodulation, and significantly increased grain. Boron in combination with either nitrogen or phosphorus enhanced growth in almost all respects, though significantly so for height, fresh and dry matter and grain; nitrogen applied in combination with phosphorus significantly retarded grain formation and failed to achieve level of significance in any other character. All the three elements when applied together retarded shoot elongation, fresh and dry weight and nodulation, but increased grain formation, though not significantly. Moong responded most favourably to nitrogen alone.

and effected an increase in yield by 60.30 % over control. Contrary to Western findings, nitrogen alone favoured nodulation and produced maximum number, volume and weight of nodules, while boron depressed these.

19. Effect of Sulphur and Calcium Singly and Combined on *Phaseolus radiatus*.

BHOLA NATH SINGH and Kailash Narain Sharma, Lucknow.

Calcium applied to *moong* (Type 1) as gypsum @ 30 lb. CaO (Ca_1) and 60 lb. CaO (Ca_2) per acre significantly increased grain, nodulation, height, root elongation, and fresh and dry matter. Ca_2 was significantly superior for grain, fresh and dry matter and nodulation. S @ 5 and 10 lb./acre (S_1 and S_2), like Ca, increased grain, nodulation, height, root elongation and fresh and dry matter. *Moong* responded more favourably to S_2 than S_1 in all respects, but significantly for grain and fresh weight. Ca and S applied mixed, proved better than when applied singly; the mixtures promoted grain, height, fresh and dry weight, except for Ca_1S_1 , which proved no better than Ca_2 , applied alone. Ca_2S_1 proved better than Ca_2S_2 , though not significantly; both were significantly superior to the rest. Root characters behaved differently: maximum root elongation and nodulation occurred when Ca_2S_2 were applied, difference between Ca_2S_2 and Ca_2S_1 being not significant. Ca and S induced earlier flowering and maturity.

20. Effect of Sulphur and Calcium on *Hibiscus esculentus*.

BHOLA NATH SINGH and KAILASH NARAIN SHARMA, Lucknow.

Sulphur tended to increased height of *Hibiscus esculentus*, thickened stem, with sturdier and thicker yet larger leaves, rich in chlorophyll, a more spready root development, earlier flowering, more weighty and lengthy fruits for vegetables than control. Increase in the dose of S from 10 to 20 lb. per acre had no significant physiological responses. Calcium did not show marked superiority over S and the physiological characteristics stood on a par, except that Ca produced slightly more height, stem being thinner; no significant difference was noticed in leaf size and branching over S-treated plants, but chlorophyll was significantly superior. Like S, Ca excelled control in all characteristics and produced even more lengthy and weighty fruits than S. The general effect of both S and Ca was to decrease chlorosis. Applied in combination, $\text{S}_{10}\text{Ca}_{60}$ enhanced height, stem girth, number of green leaves, root development (weight and spread), leaf size, and chlorophyll; the outstanding contribution of $\text{S}_{20}\text{Ca}_{60}$ was prominent in dry and fresh weight of shoot, in the higher number, fresh and dry weight, and greater water-content in the fruits—a quality that should fetch better value for vegetables. S and Ca, applied in mixture, proved more efficient than when supplied singly.

ORGANIC GROWTH PROMOTING SUBSTANCES AND CROP PRODUCTION:

21. Effect of Hormones on Growth Performance and Yield of Paddy.

BHOLA NATH SINGH and BAL GOVIND DABRAL, Lucknow.

The action of α -naphthalene acetic acid and 2:4 dichlorophenoxy acetic acid in 4 conc. from 1 to 4 p.p.m. administered at 3 successive stages, viz, germination,

tillering and pre-flowering, were studied on paddy. a-Napthalene acetic acid (2 p.p.m. applied at 3 stages, increased growth, height and tillering; 1 p.p.m. produced maximum number of leaves; dry weight was maximum from 2 p.p.m. administered twice. The 2 p.p.m. of 2:4 dichlorophenoxy acetic acid, administered 3 times, gave maximum height. Maximum number and weight of grains were recorded for 2 p.p.m. a-napthalene acetic acid applied 3 times. The disadvantage in the high yielding early paddy (T 136) is the shedding of grains, attenuated by weather conditions in that if rainfall was excessive and untimely at seed maturity, it induced lodging and grains shed from 10 to 15% in the swamp amounting to serious loss due to germination or rotting of seeds shed. As a result of a number of methods tried to check shedding of grain of this early type, 2 p.p.m. a-napthalene acetic acid, administered 3 times gave not only maximum number and weight to grains but checked effectively grain shedding to almost 90%. This method may usefully be tried to save loss by shedding.

Section VII. : ZOOLOGY & ENTOMOLOGY.

SATYA NARAYAN SINGH and RAMCHANDER RAO, Hyderabad-Dn.

1. An interesting case of Human infection with *Physaloptera* from Hyderabad-Dn.

In this paper *Physaloptera* sp., forming an abscess in the neck of a patient in Hyderabad is recorded. A brief account of the parasite is given and it is shown that it is not identical with the human worm, *Physaloptera caucasica* which is a parasite of the intestine of man. It is concluded that the human infection described herein is purely accidental.

2. The Pathological significance of the infestation of the Diptera and its larva on animals.

ANUPAM CHATTERJEE, Darjeeling.

Diptera or flies spread more than one disease in animals and their economic and pathological significance is important. The Buffalo-gnats or the Simuliidae, apart from their desquamative role on the host's epithelium, have recently been suspected to transmit the bacillus of the fatal epidemic of Haemorrhagic Septicemia in animals thus taking a large toll of life every year. The Tabanida and the Muscida are also very important as carriers of different diseases and the maggots of the latter render thousands of cattle useless due to the attack of Foot-rot. *Tabanus bovinus*, *T. autumnalis*, *T. morio* and *T. tropicus* transmit the protozoon of Trypanosomiasis and the loss sometimes is heavy. The flies of the genera *Stomoxys* and *Glossina* also transmit the same disease and naturally attract much pathological importance. The Bot-flies of the genera *Gastrophylus*, *Oestrus* and *Hypoderma* are also of much importance. *G. intestinalis*, *G. pecorum*, *G. haemorrhoidalis*, *G. intermis*, *G. verterinus*, are responsible

for certain forms of debility in the animals they infect and the larvae after a preliminary migration, attach themselves to the wall of the stomach and thus interfere with the passage of food. The Warble flies are most important in so far as the economic loss is concerned. *H. bovis* and *H. lineatum* spoil an appreciably large number of hides and their larvae perforate the skin of their hosts, thus incurring loss of crores of rupees from the loss of hides and also turn the meat of their hosts quite unfit for consumption. *Oestrus ovis* is responsible for a heavy loss amongst sheep. Thus, the significance of these flies cannot be overlooked.

3. On the epaxial and the caudal muscles of Sauropsida.

J. C. GEORGE and LAKSHMI UNNI, Baroda.

The spinalis--semispinalis muscles in the lizards and crocodiles show an essentially metameric composition. The spinalis muscles cross the semispinalis and a criss-cross arrangement which is responsible for the movement of vertebrae individually and collectively, results from this arrangement. Lying lateral to these is the longissimus dorsi, a longitudinal mass of a muscle which is crossed by delicate tendinous divisions reflecting its essential metameric nature. The epaxial muscles work in unison with the hypaxial ones in lizards and crocodiles in the lateral flexion of the body and so in forward movement, though not to the same extent as in fishes and tailed amphibians. In the snakes the longissimus dorsi shows lateral divisions with conspicuous muscle bellies connected by tendons. This arrangement is a modification which brings about the lateral flexions characteristic of the group. In the Chelonia the epaxial muscles are reduced and have lost their typical form. In the birds such a reduction is confined to the regions where the vertebrae are fused, whereas in other places though the longissimus is reduced, the essential lacertilian pattern of the spinalis-semispinalis is retained.

In the tails of lizards and crocodiles in addition to the spinalis-semispinalis system, there are the ilio-caudalis, ischio-caudalis and caudo-femoralis muscles. In the birds though the tail is abbreviated, the muscles are all present, though somewhat differently disposed.

The birds possess so many similarities with the reptiles that they have been sometimes grouped together under Sauropsida. The morphology of the epaxial and caudal muscles in the two groups also justifies such a grouping.

4. A Note on the Cranial Osteology of *Uromastix hardwickii* (Gray).

J. C. GEORGE, Baroda.

The chief differences in the skull structure of *U. hardwickii* when compared with *aegyptis* are noted. The processes nasalis in *hardwickii*, do not reach the frontals; the fontanel is covered by the frontal; the postfrontals are wanting; the parietal foramen is in the fronto-parietal suture; no vacuity between the palatopterygoid bones is present and the pterygoids extend up to the fusel posterior margin of the prevomers.

5. The Chemical composition of the pectoral muscles of some Indian birds and its bearing on their flight.

K. K. NAIR, Bombay.

The two chief wing muscles of *Columba*, *Corvus*, *Psittacula*, *Passer*, *Milvus*, *Gallus* and *Anas* have been examined as to their chemical composition. The *major* muscle showed a higher percentage of solids than the *minor*. The combined value of fats plus carbohydrates,—an index of contractile metabolism was greater in birds which indulged in long flights (e.g. parrot), while in the fowl the protein percentage was great indicating formative metabolism. Similar comparative data are provided for water, ash content, and iron.

6. Contribution to our Knowledge of the Structure of Placenta of Felix Tigris—The Indian Tiger.

SHYAMA CHARAN SRIVASTAVA, Gwalior.

Most of the study of the placental morphology of the Order Carnivora has remained confined to the domestic animals like cat and dog. However, A. Robinson has given a brief and general account of the placenta in Leopard and stated that it is similar to that in cat and only Dr. A. Subba Rau, my revered teacher, has given a detailed account of the placental morphology of a shed placenta in *Ursus*. Thus the present paper deals with the study of the placental morphology of the most wild animal—*Felis tigris* and is new. The following observations have been recorded by the author :

1. The placentation in Tiger is zonary like that in Cat but its location instead of being equifurial as in Cat is in the proximity of one of the two poles of the gestation sac.
2. The yolk-sac is highly compressed and is found in the exocoelome on the mesometrial side. It keeps apart the two sides of the allantoic vesicle.
3. The base of the umbilicus shows two veins, an artery and the allantoic stalk but the artery soon divides so that each side of the allantoic vesicle receives an artery and a vein.
4. The marginal haematomes though present yet are nominal and do not show any special colouration as seen in the placenta of the cat.
5. The placental labyrinth is lamellaeform like that in the cat but the villous tips are not as broad as I have examined in *Herpestes*.
6. The type of the placenta is endotheliochorial.
7. The syncytiotrophoblastic cytoplasm investing the maternal vessels is not as thick as in the dog but is thicker than what it is in the cat.
8. No giant cells, as noticed in the placenta of the cat, could be noticed in that of the Tiger.

7. Contribution to our Knowledge of the Placentation in *Bhinopoma* Kinneari.

SHYAMA CHARAN SRIVASTAVA, Gwalior.

Wimsatt (1944 b) stated that the study of the placental morphology in the Order Chiroptera is comparatively much less than what it is in many other groups of Mammals. This Order has 16 Families but the study of the placental morphology has so far been made only in 8 of these. However, the Family

Rhinopomidae, to which the present specimen belongs is new for the study of the placental morphology and this study has revealed the following interesting features :

(1) In Gwalior, *Rhinopoma* breeds only once a year i.e, from 1st week of April to 1st week of July. (2) The uterus is bicornuate and the pregnancy can take place in any one of the two horns. (3) The implantation of the egg is superficial and circumferential and the orientation of the embryonal area is lateral. However, this site gradually shifts to the mesometrial side. (4) The placenta is formed all over the inner surface of the gestation sac but gradually becomes confined to the mesometrial side. This fact is in contradiction to the general rule that the members of the Microchiroptera group possess placenta on the antimesometrial side. (5) The final shape of the placenta is that of a saucer with an irregular rim and this is asymmetrically situated with respect to the mesometrium. (6) The chorio-allantoic placenta is endotheliochorial (Otto Grosser) as in the Families Rhinolophidae and Molossidae. (7) The structure of the placental labyrinth is lamellaeform much like that in Carnivores. (8) The yolk-sac persists till term and transforms into a gland of internal secretion. This sac finally becomes adposed to the foetal surface of the placenta on account of its gradual shifting from lateral to the mesometrial side of the gestation sac.

8. The occurrence and distribution of lipids in the placenta of the Indian Musk Shrew, *Crocidura caerulea*.

N. OWERS, Nagpur,

A variety of histochemical procedures were used to ascertain the presence of triglycerides saturated and unsaturated, phospholipids, cholesterol and esters, and fatty acids, in the foetal and maternal tissues of the uterus during the main stages of gestation.

Lipid droplets were present in all maternal tissues, epithelium of the uterus, the endometrial connective tissue cells and in the endothelium lining, the maternal blood vessels. The cells of the maternal tissues appear to contain a progressive accumulation of lipids. Later these degenerate and liberate the lipids. The lipid droplets appear to be absorbed by the invading trophoblast cells in the placental labyrinth. The maternal blood vessels appear to be loaded with lipid particles throughout gestation but the quantity appears to increase gradually from the early stages and to reach a maximum amount in the later stages.

The trophoblast of the bilaminar omphalopleure appears to obtain lipid material mainly from extravasated blood. Steroids are present in the trophoblast cells of the yolk sac and are not observed elsewhere in either the maternal or foetal tissues. It is therefore concluded that the trophoblast of the bilaminar omphalopleure is a source of production of the placental steroid hormones.

The physiological significance of the different lipids in the various placental constituents is discussed.

Section VIII.: ANTHROPOLOGY & ARCHAEOLOGY.

1. The Enumeration & Treatment of Tribes in the Indian Census. A study in Retrospect.

N. K. SHYAM CHAUDHURI, Calcutta.

The scheme of classification, adopted in different Census operations are dealt with and the difficulties pointed out. It is suggested that religion as a criterion for determining community membership should be replaced by a non-objective racial classification.

2. Kinship Terms among the Khasis.

Dr. EHRENFELS, Madras.

The author examines a number of kinship terms prevalent among the Khasis and tries to find out their relation with the social organisation.

3. Where is Ptolemy's Kirradia ?

MONORANJON GUPTA.

In the present paper based on newly found records, the author suggests that Pentapolis was the Head Quarters of Panchanagari-Vishaya and this was identical with modern Panchbibi. Extensive ruins of the city are being still seen around the Patharghatta Fair on both sides of the small stream Tulsiganga about 2 miles north-east of Panchbibi Rly. station. Chaturgram, the most northerly part of Kirradia gave its name to Chaukhundi also known as Ghoraghat. And the area in-between was Kirradia.

4. Kinship Terms and Social Organization among the Khasi of Assam.

U. R. EHRENFELS, Madras.

Social and cultural anthropology researches among the Khasi were carried out with the financial aid of *Viking Fund* Grant in 1949/50 in the frame of comparative studies of matrilineal civilizations in India. The collection of kinship terms among four groups showed differences in parts. The groups from whom material was collected were : Plateau Khasi, War Khasi, Plateau Jaintia and War Jaintia.

Among the kinship designations of significance to social organization and the culture-historic background of the Khasi *Kha* or Dihun among War Jaintia deserves to be mentioned ; indicating relationship on the paternal side. The use of this term as an integral kinship designation in a matrilineal group of societies reflects on the formerly often repeated view that matriling was an outcome of ignorance about the biological role of fathers.

The honorific significance of I—a term of diminution—and the functional use of the terms *Hap* (younger siblings or cousins) and *Kong* or *Bah* for elder ones, illustrate particularly Khasi attitudes to older and younger relatives. These finds also expression in the position of the youngest daughter—the *Ka Khun Khaddu*.

The above kinship terms and the use of *U Ni—U Kong* (maternal uncles and husbands of elder sisters and female cousins) as a honorific expression illustrates two important features in the structure of the Khasi matrilineal family, viz.: a democratic basic family situation and respect for elder male members, inspite of the legally protected preferential position of the weakest (women and youngest) family members.

The terms for great-grand-children *Khun Miau* (cat's children) may be taken to indicate a former connection with the Miau, a tribe in South-East Asia, also speaking an Austro-Asiatic language, like the Khasi.

The Khasi terms for plains people (Dkhar) and Assamese hill-people (Paro Riew Lum) illustrates an attitude of outgroup feeling towards the former and the opposite towards the latter which has parallels in behavior patterns.

Section X.: AGRICULTURAL SCIENCES.

1. The Relation of Meteorological Conditions to Wheat Production in Uttar Pradesh.

BHOLA NATH SINGH, Lucknow.

As a result of very large number of field experiments conducted on uniform basis under the varied soil and climatic conditions of Uttar Pradesh, it was shown that, of the meteorological conditions, rainfall proved most responsive: between 25–40 in. rainfall wheat thrived and increased yields: rainfall above 40 in. proved deleterious but was advantageous to paddy. September rains helped seed bed preparations, high germination rate and early establishment of wheat roots; late sowings due to October rains reduced yields; that during March tended to induce lodging in manured plots and effectively lowered yield. As opposed to Western findings, high temperatures increased leaf size but reduced amount of plant substance per unit area, while reverse was true for relatively low temperatures in the hilly tracts.

2. Relative Efficiency of Methods of Sowing and Placement on Germination, Growth, Development and Outturn of Wheat.

BHOLA NATH SINGH, Lucknow.

Methods of sowing exercised dominating control on germination, growth, developmental characters and outturn of wheat. Drilling proved more efficient and

remunerative than either broadcasting or sowing by hand behind plough, and secured adequate germination, conditions for early root growth, tillers, ears, efficient NAR, superior ear characters, numerically larger and filled grains and 20-25 % higher yield at almost half the seed rate (25-30 srs.), compared to other methods with practically double seed rate (40-60 srs.). When growth and yield proved less remunerative; the larger seed rate practiced to mitigate the chance factor was not commensurate with high percentage of ungerminated seeds due to inadequate placement. Drilling thus increased yield with substantial reduction in seed rate that may be saved to meet present food crisis. The sharp decrease in soil moisture and the falling permeability and soil moisture in the surface soil created unfavourable conditions for germination and early root establishment, reflecting increasingly on our traditional sowing practices. The more favourable early start in life and effective growth of roots through drilling would be a prerequisite for shaping plant's subsequent physiological activities and yield. Use of cheap devices of seed drills are thus essential in scientific crops planning and production.

3. The Relation Between Seed Rate and Plant Population and its Effect on Growth and Yield of Wheat.

BHOLA NATH SINGH, Lucknow.

Relative abundance of plant population on unit area, capable of supporting the population, is shown to be a dominant factor in crop production. Seed rate and plant population stood in close physiological relation with growth, development, and yield of wheat sown to varying seeds rates and methods of sowing in field experiments over a wide range of soil, climate and cultural conditions of U. P. Optimum seed rate of 10 srs. (dibbling) and 25-30 srs. (drilling), increased yield upto 35 mds., and 32 mds./acre respectively; other seed rates were least remunerative. High seed rate (52-60 srs.) resulted in considerable wastage of seeds, and caused serious root and shoot competition and loss in nutrient uptake and photosynthesis. With increased population, there was deterioration in NAR, growth rate, dry matter, tillering, earing, number and length of ears, maturity, grain number, yield and quality. In the early stages, low plant number was associated with less number of tillers, later, this was compensated by increased tillering, more ears, and larger outturn. The larger seed rate was wasteful, for, ultimately the larger number stood in closer competition on limited supply of nutrients and water for reduced yield and quality, than when sown and maintained thin. Individual plants held 1 ft. apart on certain soils (by reducing seed rate) seemed necessary for ensuring least mortality, better stand, reduced lodging, higher tillering with longer ears richly laid with well-filled grains and maximum outturn. Optimum seed rate would have to be worked out for each soil, climate, cultural practice, rotation and genetic material and would thus effect larger savings on seed wastage to meet country's growing food needs.

4. Effect of Overcrowding, Root and Shoot competition and Spacing on Growth of Wheat,

BHOLA NATH SINGH, Lucknow.

Yield from a particular area was the sum total of individuals composing the population supported by that area of land. The field conditions under which

yield (Y) was greatest was determined under the relatively controlled conditions of nutrients in pot culture and field ; also when the multiple of plant yield and number (ny) was the greatest. With increase in available space and soil nutrients in pots of increasing size for root development and plant size, dry matter elaboration, growth, developmental attributes, and outturn of wheat increased till a condition was reached that further amount of soil (nutrition) failed to secure any proportionate increase in these. When plants of equal size giving optimal yields under optimal nutrition were crowded together by arranging in juxtaposition to one another, packed closely, there followed considerable deterioration in growth and yield, even though soil nutrients were maintained at optimum. On increasing the seed number in pots of same size, in separate sets of experiments conducted, there was in evidence considerable adverse effect on growth and yield of wheat, even though the pots were kept far apart free from shading effects. This demonstrated the operation of limiting factors as due to individual counts of overcrowding and competition and to lack adequate nutrition following an increase in population competing for limited nutrition.

5. Seed Rate and Crop Density in Crop Production.

BHOLA NATH SINGH, Lucknow.

Field experiments with same and differing species growing mixed, gave remarkable confirmation of the principle of plant competition as effects of seed rates. In substantially reduced seed rates roots traversed in all directions round about a centre, the simplest case was that the areas drawn upon by neighbouring individuals did not enter into competition ; each plant developed unrestricted for unlimited supply of nutrients and water. With gradual increase in seed rate, a condition was reached when plants combined maximum yield with maximum number of individuals ; any closer association in increase of population within unit area resulted in root interference, failing to make top use of soil, to achieve which, the united root systems must traverse to every region of unoccupied soil, requiring increase in seed rate still further. There thus arose a competition between the neighbouring plants for available food and water supply ; fertility level and soil moisture determined to what extent the land could support increased population. Thus yield of individual diminished : being made good by the number upto a limit set by nutrition factors and harmful root excretions, increase in seed rate beyond which proved ineffective and wasteful : there was larger mortality and reduction in tillering and ear characters. The inter-plant distance for largest yield for light loams of U₄ P. was about a foot and the corresponding plant population per acre of the order of 45,000. The relation between plant number and yield was, however, not a simple function of individual factors.

6. Effect of Seed Rate, Manuring, Irrigation, Fallowing and Cropping of Single and Mixed Crops on Weed Infestation on Farm Land.

BHOLA NATH SINGH, Lucknow.

Weeds are natural pest on farmland and provide the most serious setback to crop production in the tropics and sub-tropics where these abound : these cause serious competition that they enter with the crops for nutrients, water and light. The eradication of these forms the greatest

of problems in crop husbandry : there is no easier and sure way of decreasing yields than by allowing weeds in competition. Precise knowledge of biological habits and stand of weeds in relation to the soil, season, weather factors, cultivation and cultural practices becomes a pre-requisite in any planning and production of crops. This led to a series of surveys and field experimentation to study their association and spread on the cultivated land. When weeds grew in competition with a crop, the effect of weed on yield of crop got a start on the weed and *vice versa*. If wheat, for instance, began to grow earlier and at higher rate than the competing weeds, wheat smothered the weeds completely and yield remained unaffected provided wheat was down thick but not too thick with higher rate than weeds. If crops plants and weeds started at the same time, thickness of planting was still able to limit the extent to which weeds can reduce crop yields, though even with thickest planting weeds caused a reduction to almost $\frac{1}{3}$ rd in wheat yield. Where weeds were already established from the previous year, with a sparse wheat crop of lean-seed rate, the weed succeeded in eliminating associated crop.

7. Effect of Fallowing and Cropping on Weed Infestation on Farm Land.

BHOLA NATH SINGH & NARENDRA NATH DIXIT, Lucknow.

Amongst the prominent weeds noticed in large numbers in the complex experiments specially conducted on a split plot design basis under conditions of cropping and fallowing, were *Chenopodium album*, *Asphodelous tenuifolius*, *Cynodon dactylon*, *Cyperus rotundus*, *Launia* sp., *Argemone maxicana*, *Solanum nigrum*, *Andropogon controtis*, *Graphelium* sp., *Blumea* sp., and *Anagalis* sp. The weeds showed general tendency of periodicity to germinate at a particular season : the cultivation practice during their dormancy succeeded little ; with the return of favourable conditions, these appeared in large numbers as if they had been sown. *Fallowing* offered undoubted supermacy to weeds and their growth was no less than the crops, in number and stoutness : On *cropped land*, high competition existed between wheat and weeds leading to sharp decline and reduction in branching and spread of weeds with diminished rapidity of growth than wheat.

8. Effect of Manuring, Irrigation, Fallowing and Cropping in Single and Mixed Cultures on Weed Infestation of Farm Land.

BHOLA NATH SINGH, Lucknow.

Dominant weed species were largely determined by the *time of cultivation* : the number stood in direct variance with interculture ; late cultivation and sowing encouraged weeds. No amount of interculture, after weeds had established and set seeds, succeeded in bringing them down ; earlier interculture succeeded remarkably well. *Manuring* on uncropped area encouraged profuseness ; that in cropped, provided the upper hand to wheat in greater rapidity to grow, and checked their stand or spread considerably. Of the manures and fertilizers used, castor cake (CC) was more effective than artificials in reducing weed intensity. Likewise, irrigation (I) alone, or in interaction with manures, gave a fillip to the crop in the rate of growth but suppressed weeds in competition ; two irrigations (I_2) proved more effective than one. A judicious selection of the smother crop and timely

methods of cultivation proved important factors in weed control : fallowing invited more infestation and profuseness. $W+CC+1_2$ gave highest wheat yields and poorest weed stand. Arranged in descending steps, *mixed cropping* effectively suppressed weeds as gram, gram + wheat, wheat + mustard, wheat + gram + mustard, wheat, mustard, fallow. Ploughing in of unseeded weeds effectively decreased subsequent appearance. The *physiological stages* of weeds and of crops had lot to contribute in the relative effectiveness of control measures.

9. Critical Periods in the Water Requirements of Wheat with and without Added Manures.

BHOLA NATH SINGH, Lucknow.

Water economy in crop's economy for dry matter formation and yield herein studied at length in field on varying soils and climate of the State with and without manures has provided the principles for practice of irrigation. The relative water requirements of crops varied : critical periods of water requirements lay generally at the physiological stages corresponding to primary root development, tillering, pre-flowering and milky stages when there was need for measured and controlled irrigation. Irrigation both below and above optimum was wasteful and least remunerative. Excessive use of canal water to reducing yields and deteriorating soil has to be checked. Interaction of nitrogen, phosphorus, Potash, etc., and soil types with irrigation revealed that nutrition was a major factor in soil moisture in cutting down crop's requirement for water and increasing its relative efficiency for dry matter formation. Mixed cropping effectively reduced water requirements, delayed maturity, and thereby yield. Two irrigations proved best with castor cake and three irrigations with sulphate of ammonia, obviously due to greater loss of water from soil owing to presence of the latter and larger water holding capacity of soil following cake in elaborating unit dry matter. Potash, singly, or with phosphorus, reduced water requirement upto 42 %, nitrogen and phosphorus decreased it by about 20 %.

10. Effect of Soil Types on the Requirement of Irrigation for Wheat in Uttar Pradesh.

BHOLA NATH SINGH, Lucknow.

Clayey loam soils of the State needed only two irrigations because of their greater water holding capacity and larger root penetration in the sub-soil ; for light loam and light sand, three, and for hilly soils even one irrigation would do for larger yields. Irrigation proved most effective in the Central Zone. Loam soils did not respond to irrigation when average rainfall was above 45 in. and responded to castor cake better than sulphate of ammonia. Light loam showed better response to both irrigation and manuring, but sulphate of ammonia proved superior to castor cake. Light sand showed marked avidity and best response to increasing levels of irrigation and manures : optimum increase in grain was achieved by three irrigations to yield 125 % over control. The relative response of irrigation and manuring was linked with the physical property of soil types and relative limitation of the manurial elements in these. With decreasing capacity for water holding, such as existed in loam, light loam, and light sand, there was consistently increasing response to levels of irrigation. The use of balanced manur-

ing, mixed cropping, and controlled quantity of irrigation at critical physiological stages of the crop are recommended to cut down duty on irrigation and for maximum yields.

11. Effect of Nitrogenous Manures on Germination, Survival and Yield of Wheat.

BHOLA NATH SINGH, Lucknow.

Wheat drilled (@ 45 srs. per acre) on loam, following 4.02 in. of October rains, gave highest germination percentage in unmanured plots compared to nitrogenous dressings of 60 lb. N/acre. Inorganic nitrogen (sulphate of ammonia) gave poorest germination; the organic (castor cake) responded better, although application of N in any form depressed germination consistently; sulphate of ammonia being quick-acting, concentrated and easily available depressed more than the slow-acting cake. Mortality of seedlings and plants was, however, more in unmanured plots, least with cake. Survival percentage of plants at harvest on the basis of germinated seeds was 40.6, 43.7 and 46.8 for no-manure, sulphate of ammonia, and cake respectively. The yield of grain was maximum with cake and lowest with no-manure.

12. Manurial Efficiency in Determining Plant Population on Unit Soil Surface and Relative Crop Returns.

BHOLA NATH SINGH, Lucknow.

With addition of manures, demand upon surface area left to individual plants became lessened. Produce of an individual under any manure was distinctly dissimilar than under others; yield decreased with super (40 lb acre) > super (30 lb.) > Gypsum (50 lb.) > Gypsum (25 lb.) > no-manure. On the basis of surface soil area left for the working of roots of individual plants, the manures in the decreasing order of efficiency were no-manure, super (40 and 20 lb.), gypsum (25 and 50 lb.). This means that soils surface per plant did not bear direct relation to grain yield conditions of manuring. While under no-manure soil surface, area per individual was maximum to support a smaller population grain was least, due to lower number of seeds of smaller weight per ear, less tiller number and ears to tillers: the characteristics would thus assume very great agricultural significance. Double dose of calcium proved best in increasing yield on soil surface area per plant basis, in that, although both the number of ear-bearing tillers and also grain yield per ear were less under the double dose of super, for gypsum could support a larger plant population. In the light of these findings it becomes necessary to adjudge the efficiency of manuring, irrigation, and other treatments that are capable of supporting a plant population, to have the optimum working soil area (volume) for maximum return. The seed rate would thus have to be accordingly adjusted in this light.

13. Effect of Doses of Phosphorus and Calcium on Germination, Survival Percentage and Yield of Wheat.

BHOLA NATH SINGH, Lucknow.

On light loam, sub-soil (6-8 in) dressings of Phosphorus to wheat (sown @ 50 seers per acre), having October and November rains, succeeded remarkably

in increasing germination percentage over no-manure. With increase in rates of application germination percentage increased, more with the dose of calcium. Mortality was highest (81.5 %) against super (40 lb. P_2O_5 /acre) and all rates of calcium increased survival percentage over super (40 lb.) and decreased mortality, calcium at lower level proved more beneficial than super at the lower dose, though not significantly. The yield of grain was maximum with 40 lb. super and least with no-manure ; both calcium and phosphorus increased grain over control ; the latter proved more beneficial than the former, and double doses proving more beneficial than the former, and double doses proving more effective than the single.

14. Effect of Forms of Combined Nitrogen, Rates and Dates of Dressings and Irrigation on Growth and Yield of Wheat and Paddy.

BHOLA NATH SINGH, Lucknow.

Several organic and inorganic manures were tried under different soil and climatic conditions of the State interacting between themselves and irrigation on wheat and paddy. The soils were, in general, deficient in N and soil moisture, often in P, S, Ca, Mn, Mo and B, N increased yields upto a certain upper limit which varied with soil types, fertility status, cropping history and cultural practices. In general, N requirement on light sand and light loam was more than on clay and heavy loam. Increasing doses of N up to 100 lb. significantly increased grain linearly further additions depressed grain, vegetative ratio and increased straw ; addition of N to soils that had supported legume previously depressed yield. Soil conditions at Kanpur, Merrut and Jhansi might best respond to optimal doses of N (50, 65 and 125 lb.). Lower dosage of sulphate of ammonia came out superior to heavier ones under sub-normal precipitation or subdued watering. Castor cake, compost, f.y.m. and certain organic ones proved better under these conditions ; higher doses of minerals had adverse effects on growth and yield under conditions of dessication. Cakes needed early and adequate quantity of water for efficient production. Excessive and early doses of N induced vegetative growth, greater tillering with less ears, more tissue moisture, less dry matter, lodging, reduction in grain and provided a fillip to pests and diseases. To induce greater up-take of N and increased N-metabolism for higher yields, it was essential to apply balanced plant food in the dressings of P, K, Ca and others to overcome effects of excessive N and yet produce higher yields.

15. Effect of Calcium, Sulphur and Phosphorus on Growth and Yield of Crops.

BHOLA NATH SINGH, Lucknow.

Calcium and sulphur are introduced as new additions to effective manurial programme of the State which are highly beneficial in raising larger crops. Applications of powdered super to sub-soil to 5-7 in. at sowing along with Ca (preceding tillering to milky stage as a second step), proved most beneficial to accelerated root respiration, root aeration, early root development, larger absorbing root surface, increased assimilating leaf surface, and maximum yield with appreciably increased tillering and least lodging. The action of Ca is obviously to slacken the rapid fixation of P in addition to its acting as a corrective of soil pH and as a catalyst in invigorating more chlorophyll and increased photosynthesis of the larger leaf area exposed by the action of both elements. So closely were Ca and P associated in the story of physiology of nutrition of cereals, legums, and other

crops, that P seemed to be the logical successor to Ca : it is practically difficult to think of the one without reference to the other. Application of S promoted sturdier and healthier plants, with higher phytosynthesis, more chlorophyll, and larger yield. Application of mixtures of powdered super and gypsum indirectly increased the uptake of N, and as such, its rendering to sub-soil is recommended as a practical measure to increase yields upto 36 % and more, and also to increase the water retaining capacity of soil for cutting down time and amount of water supply.

16. Importance of Correct Proportion of Added Manures and its Economic Value in Crop Production.

BHOLA NATH SINGH, Lucknow.

Addition of equal amounts of nitrogen, phosphorus, calcium, sulphur, and other manures, failed to produce equivalent returns in the yield. On an economic basis, excessive application of these beyond the required optimum did not prove remunerative equal to the additional expenditure incurred. Series of experiments testing the use of varying rates of Ca, S etc., have remarkably illustrated the interaction of elements for balanced nutrition in crop production. It was more the fertility of soil, less the soil type, that was important in crop production. P and Ca indirectly increased grain yield by the greater uptake of N. Additional N was needed for potato, maize, and other exacting crops in the wetter regions and seasons of the State and on phosphate-deficient soils : cereals and legumes also needed P under these conditions. Short supplies of Ca and K or wood ash reduced lodging.

17. Residual Effects on the Succeeding Crops of Added Combined Forms of Nitrogen.

BHOLA NATH SINGH, Lucknow.

The relative effectiveness of forms of nitrogen applied to wheat on yield and residual effects on successor crop was studied. On light sand, sulphate of ammonia increased yield in maunds to the acre by 11.0, ammonium phosphate 7.0, castor cake 5.0, ammonium nitrate 4.8, linseed cake 4.6, f.y.m. 3.9, and poultry manure 3.5. The increases in yield in the succeeding *Kharif* was 4.7, for ammonium phosphate, 3.5 for stable manure, 2.2 for poultry manure, and 2.0 for f.y.m. Thus ammonium phosphate that was inferior to ammonium nitrate for *Rabi* proved best in the following *Kharif* presumably because phosphorus got fixed up in the soil and was made available later. There is evidence of residual effects of almost all types of manures but this depended upon the rapidity with which its constituents in the soil were either fixed up or lost.

18. Effects of Soil Types and Locality on the Production of Wheat.

BHOLA NATH SINGH, Lucknow.

Studying the effects of soil types and locality on wheat in the State, it was shown that wheat did best on heavier soils such as loams and clay loams, and while bread wheat made the best growth on the alluvial soils, it also did well on

Kabar soils where durram proved most successful. Wheat growing on loams tillered well, produced stiff straw and ears richly set with grains capable of yieldings 25-30 md. per acre without difficulty : with change in climate such differential responses between the lighter and heavier loams lay in the balance of aeration and water supply, as with a tendency for the loam to become heavier, the balance was altered in increasing water holding capacity but to a reduction in the supply of aeration to roots. Calcium clay proved most favourable to growth of wheat and the addition of this element responded in its early growth and tillering ; lack of calcium in control plants developed change in pH of soil which aggravated harmful effects.

19. Effect of Cut vs. Whole Seed, Potato on Its Yield.

BHOLA NATH SINGH, Lucknow.

Good deal of misconception prevails among cultivators on the use of seed size of the notoriously expensive seeds of potato ; they cannot simply afford to spend larger sums of money on seeds and would prefer to have small sizes to give larger number, or achieve the same result by cutting these in pieces containing bud in each to enable the covering of larger area at less cost for smaller mass of potato material. It is not all the same clear as to what mass of tuber material would provide the optimal limit, capable of supplying adequate nourishment to the developing vine for highest yield. Potato seed (var. Military) tubers ($1\frac{1}{2}$ in. dia.) when cut in two's and four's and sown under uniform soil conditions depressed yield, though significantly only in $\frac{1}{4}$ th cut pieces over the 'whole' and 'half-cut' tubers. A large seed and a high economy of working, represented by a large efficiency index, would thus allow of highest production of vegetative material : a good start will mean a large capital to work, for, the efficiency of a plant is highest during its earliest growth stages. Highly significant increase in yield were obtained in the 'whole-minus-periderm' (with buds intact); 'half-cut' and 'whole-minus-pith' failed to give significant differences. With the mass of the peeled tuber remaining almost the same, if not a little less than 'whole tubers,' the doubling of yield in 'peeled' ones is most economic and worth the pains without involving to any great labour, peeling of which could be secured through a simple mechanical device.

20. Effect of Seed Size on Potato Production.

BHOLA NATH SINGH and BABU SINGH BALYAN, Lucknow.

Seed size of potato (var. Military) affected yield manifestly. Increase in size of potato seed in the gradation of 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ in. dia. with average individual weight of 10, 15 and 28 gm. respectively of each size category, was followed by linear and progressive increase in yield in the randomised replicated field trials on light sand under uniform cultural conditions; that from $1\frac{1}{2}$ in. tuber highest ; optimum size remains to be settled towards yet larger size. There was no appreciable and significant difference between the yields of the two lower categories of 1 and $1\frac{1}{4}$ in.; sizes lower than 1 in. dia. category decreased yield and were uneconomic.

21. Effect of Nitrogen Doses on Tuberisation and Yield of Potato.

BHOLA NATH SINGH and CHAUHARJA SINGH, Lucknow.

Nitrogen in increasing doses on light sand increased both tuberisation and yield of fresh potato (var. Military) significantly upto an optimum of 80 lb. N/acre and gave highly significant response resulting in 177 % increase in yield over control. Further addition of nitrogen upto 120 lb. was without any beneficial effect, though it was still significant response resulting in 177 % increase in yield over control. Further addition of nitrogen upto 120 lb. was without any beneficial effect, though it was still significantly superior to no-addition.

22. Effect of Size of Dressing of Superphosphate on Potato.

BHOLA NATH SINGH and CHAUHARAJA SINGH, Lucknow.

Increasing doses of phosphorus upto 75 lb. P_2O_5 /acre on light sand, with uniform basal dressing of compost increased both tuberisation and yield of potato (var. Military), tubers as also fresh and dry matter accumulation, increase being significant. The optimum for Phosphorus may vary with the nitrogen status of soil.

23. Effect of Calcium Alone or in Combination with Phosphatic and Farmyard Manures on Potato.

BHOLA NATH SINGH and BABU SINGH BALYAN, Lucknow.

Application of superphosphate, ammonium phosphate, bone meal, farmyard manure and gypsum, increased significantly yield of potato (var. Gola) tubers, whereas fish guano failed to give significant increase. The interaction of Phosphorus with calcium (gypsum) failed to increase significantly the yield of tubers over both phosphorus and calcium when applied singly.

24. Experiments on Mixed Cropping Practices : Effect of Changing Proportionality of Seed Rates on Growth and Yield of Associates.

BHOLA NATH SINGH, Lucknow.

In no other part of the world has mixed cropping been practiced on such wide scale as in India, yet its scientific basis has remained obscure. Field experiments conducted to determine optimum ratio of seed rates for composing seed mixture for maximum return, under varying soil and climatic conditions of U.P., revealed that there was great elasticity in composing optimum ratio under varied cultural conditions. These gave excellent example of suppression of the one grown thin with smaller seed rate and the relative speed of growth of associated crop; the one grown thinly and possessing a relatively smaller growth rate suffered defeat in giving upper hand to the associated crop with larger seed rate and higher growth rate. Manuring or irrigation aggravated responses in the direction in which these proved helpful to growth. Defective seed rate of mixture not only considerably lowered yield but also reduced soil fertility. Optimum seed rate of mixtures produced higher returns, with better residual effects for succeeding crop at no

extra cost, a finding of great economic value. Thus, for wheat, gram, and pea mixtures, the optimum ratio could be recommended as W:G::80:20 and W:P:40:60 to increase total yields by 55% and 44 % respectively and maintain soil fertility.

25. Experiments on Mixed Cropping Practices : Effect of Manuring and Irrigation on Growth and Yield of Crops Grown Singly and Mixed.

BHOLA NATH SINGH, Lucknow.

Effect of manures and irrigation on mixed cropping proved difficult to estimate: nitrogen, for instance, increased yield of crop mixtures, but the increase was through the cereal component, and the legume associate suffered by the intensified competition to adverse effects on its yield and protein content. The symbiotic effect of legume nodules, its number, size, weight and bacterial activity as influenced by composing mixture, showed double association of nodule bacteria in the supply of accessory growth factors in addition to acting as source of nitrogen for crops grown mixed. Defective association of mixtures produced inhibition on growth and development of associates; this has to be avoided in cultivation practice. Mixed cropping of wheat, gram and mustard proved best for wheat but decreased root length, number of nodules and yield: for the legume, association of both or either proved detrimental. Root development and yield were increased when wheat and gram were grown singly: the useful effects on larger produce is traced to hormonal secretion from the competing roots, while the harmful effects are ascribed to excretion of toxins that were also encouraged by thick sowings due to greater root competition. In the light of these, the age-long faulty practice of uncongenial association of crop species and adverse seed rate proportionality have to be effectively discouraged.

26. Effect of Rotation on Soil Fertility, Growth and Yield of Crops.

BHOLA NATH SINGH, Lucknow.

Field experiments laid on differing soils and climate of U. P. to study residual effect of previous crop on the succeeding one revealed that alternation of legumes with non-legumes and mixed cropping were essential for healthy growth and large yields to provide balanced food and fodder and also for maintaining balanced nutrients and desirable physical properties of soil. As against Western findings, where mixed cropping and rotation are not widely practiced as rigidly, remarkable deterioration in yields, and soil fertility, were experienced by practicing monoculture. Continuous cropping of legumes proved no useful purpose either; there was more of N to induce malnutrition and lodging and to derive its ill effects of excessive N. Application of N after green-manuring, likewise, proved definite hinderance to growth and yield, but its absence gave larger returns and increased water holding capacity of Soil. Fallowing was definite advantage to succeeding crop for increased yield and soil productivity but it encouraged weeds that removed nutrients. The taking of *moong* (Type I) half-way in summer fallow, proved definite advantage in suppressing weeds in competition and fixed more N than even green-manuring with sannhemp; the *Rhizobium* sp. were more efficient, and because of relatively less vegetative growth of this legume, part of N fixed symbiotically that should have otherwise been consumed in supporting larger dry

matter in a legume like sannhemp or *Cajanus indicus* is economised and left behind as balance in soil.

27. The Relative Efficiency of Combined forms of Nitrogen on the Physiology of Growth and Yield of Crops Raised on Different Soils of U. P.

BHOLA NATH SINGH, Lucknow.

Experiments conducted on uniform basis over large range of soils and climate revealed that castor cake proved superior to sulphate of ammonia on most soils in improving yield beyond 25 %. On loam and light sand, organic N was more useful than inorganic. The overall beneficial action of organics is ascribed to combined physical, chemical and biological effects on soil and also the extent that organics supplied growth-promoting substances: in contrast to combined inorganic N, cake significantly augmented chlorophyll, leaf area and photosynthesis. Effects of N were more marked on leaf area (LA) than NAR: variation in dry matter production thus became a function of increasing leaf surface which held intimate relation with yield: LA varied with the supply of water as an interacting factor, the effect being greater in combination with nutrients, more particularly N which induced early development of chlorophyll and LA, but not photosynthesis proportionately unless P and Ca were also present. The increased LA is of great significance in agriculture as it leads to consumption of large amounts of N, which in turn stands the crop in good stead when leaves are attacked by insects. Excess of N interacting with increased water supply tended to induce lodging, pest infestation and reduced yield unless balanced manuring and restricted supply of water were applied to meet adequately the critical periods in their requirements during the specific physiological stages of the crop.

28. Physiological Stages as Representative of Critical Nutrient Requirements of Crops.

BHOLA NATH SINGH, Lucknow.

The critical period of nutrient requirements of crops was during the vegetative 'growth' of plant; upon unit dry matter elaborated during this stage depended the subsequent 'development' and yield. During growth, application of manures proved most effective at root development, tillering, shoot expansion; during 'development' at pre-flowering and milky stages, in case wholemeal application of manures with planting was inadequate, or unavailable, depending upon the quality, quantity and proportion of manure added, to meet the demand of the fast assimilating flag leaf for supplying photosynthates to the developing seeds. Application in divided instalments was thus useful in that it was saved from being fixed or leached and in the preventing of profuseness of vegetative growth that effected decrease in grain/straw ratio. In wheat, time of application of fertilizers gave no significant difference directly to grain yield: there was more straw produced with dressing all at planting: with late application, N content in grain was increased. For paddy, on light sandy soil, both nitrogenous and phosphatic fertilizers produced maximum grain when applied wholemeal all at transplanting: this may be followed with advantage in paddy manuring.

Section XI. : PHYSIOLOGY

1. Double Role of Respiration.

S. N. MATHUR, Lucknow,

In the last Science Congress the author read a paper on the "Role of Vagus in Respiration." There it was shown that the vagi nerves on which the "Hering Breur" reflex, cutting short the depth of respiratory efforts, depends were far more responsible for the regulation of temperature than for the exchange of gases. These observations have found confirmation from two other directions—one, the effects of breathing 5 to 16 % Co_2 and Oxygen mixtures in winter and summer, and two, the effects of deep breathing of various depths in different seasons of the year. It was found :

I. In breathing Co_2 and Oxygen mixtures :—

- (a) Depth of breathing is directly proportional to the percentage of Co_2 .
- (b) There is a rise of temperature as the depth of breathing increases with a simultaneous tingling sensation throughout the body and formation of beads of sweat in the axilla.
- (c) Higher percentages of Co_2 could be breathed for longer times in winter than in summer.
- (d) Sense of oppression was earlier in summer than in winter.
- (e) While the above facts were observed by the author on himself ; in animal experiments better oxygenation of blood was found as the depth of breathing increased on 5 % Co_2 and oxygen mixture.

II. In deep breathing exercises on the author himself it was observed :—

- (a) That by proportionate increase in depth of breathing the number of respirations could be cut down from 15 to $1\frac{1}{2}$ per minute.
- (b) That though in winter the respiration, at the lower figure, could be continued indefinitely at rest, it was not so in summer.

III. That with the increase in depth and duration temperature rises culminating in sweating, starting first in axilla.

IV. That while very little effort is required to cut down the rate from 15 to 3 per minute definite effort is required beyond that.

V. That lowering of the rate and simultaneously increasing the depth upto a limit-increases the sense of well being :

It is safe to conclude from the above observations that respiratory mechanism serves two purposes ; the depth regulating the oxygenation and the rate, the temperature.

2. Reflex Control of Respiration.

S. N. MATHUR and M. S. CHOWDHURY, Lucknow,

The observations of the preceeding paper on "Double Role of Respiration" showing that the rate of respiration is more important for the control of tempera-

ture, have found further confirmation by experiments on dogs. In them a new and additional reflex mechanism of the control of the rate of respiration has been found which usually remains in abeyance till the temperature rises beyond a critical point which is over 41°C . rectal temperature. This additional mechanism is the reflex from the mouth. It has been found that beyond the critical temperature the rate of respiration further rises very appreciably if the mouth of the dog is kept open than when it is closed. The increase and fall in rate is regularly observed by opening and closing the mouth. It appears that with the rise of temperature muscles of the jaw lose their tone and the lower jaw drops on account of gravity to operate this—additional mechanism for the increase in rate of respiration and thus to further add to the loss of heat through breathing. As dogs solely depend for the regulation of temperature on breathing this additional mechanism gains special significance.

3. Further Observations on "Colon Gastric Reflex."

S. N. MATHUR and A. S. SHARMA, Lucknow,

In a previous Science Congress the senior author read a paper on "Colon Gastric Reflex" in which, on the basis of observation on self, it was shown that in the act of defaecation there is a rise of Ph in saliva which in its turn depended on its fall in the stomach due to a reflex starting from the colon. This was named as "Colon Gastric Reflex" as the opposite of Gastro-Colic Reflex. These observations have found their further confirmation in animal experiments on dogs.

In anaesthetised dogs toy balloons were introduced in rectum and other parts of the Colon to induce movements. From a window in the stomach the changes in its secretion and Ph were noted. It was found that secretion increases and Ph falls.

Its contrary was also noted. When the Colon does not move but is only distended, the Ph does not fall and may even rise, though secretion may still increase. These are nature's mechanisms for the better disposal of the food from the stomach.

4. Pressure Receptors in Arterial Branches.

S. N. MATHUR and H. C. Tandon, Lucknow,

Carotid sinus and the arch of aorta lodge special pressure receptors. On looking at their nature and position it appears that these places are specially prone to be affected by pressure changes and if this may be the reason there may be other places in the arterial system—say the important branchings—which may be similarly effected.

On working on dogs it has been found that there are other places also. After testing various important branchings it has been found that the most important branch is the first big branch of the femoral. Next in importance is the brachial. Other branches in the body were insignificant. With Faradic currents applied at the main branch in the femoral there is a significant fall in blood pressure of nearly the same order as in the Carotid sinus. Other methods of influencing it are in progress.

5. Antivitamins in the biochemical and physiological study of Vitamin Function.

P. S. SARMA, Madras,

Three antivitamins, desoxypyridoxine, avidin and gammexane were chosen for a study of the biochemical and physiological behaviour of the water soluble vitamins. The investigations were carried out with the fungus *Neurospora*, the insect *Corcyra cephalonica* St and in the rat as well as with germinating green gram (*Phaseolus mango*). The conversion of tryptophane to nicotinic acid has been found to be influenced by desoxypyridoxine and the extent of inhibition by the antivitamin was dependent on the optical isomer of tryptophane which was employed in the investigation. Sugars such as fructose also appear to have a retarding effect on the biosynthesis of nicotinic acid from tryptophane. The role of pyridoxine in the biogenesis of ascorbic acid during germination has also been investigated by means of desoxypyridoxine.

With avidin, it has been observed that biotin has an important function in the desaturation of higher saturated fatty acids. It has also been observed that biotin leads to an increased uric acid excretion in the rice moth larvae (*Cyrcyra cephalonica* St) and to increase urea excretion in rats. Experiments carried out with pure gammexane, the antivitamin of inositol in rats and during in vitro incubation of pigeon pancreas slices have shown the importance of inositol in carbohydrate metabolism.

6. Blood Pressure studies in Progressive Coarctation of the Aorta.

I. C. GUPTA, Darbhanga,

We, by our experience, have been able to experimentally reproduce in dogs systolic rise in blood pressure by stenosizing the aorta at the same site where nature does in cases of coarctation in human beings and have further shown that all degrees of this systolic rise in the blood pressure are possible depending upon the degree of coarctation. We have also shown that since most of the patients of coarctation which have been diagnosed have usually a feeble pulsation in the femoral artery, the degree of stenosis has not reached the critical level at which the diastolic pressure suddenly falls. Even if the coarctation is of extreme degrees, there is probably enough collateral circulation to allow sufficient amount of blood in the upper portion of the thoracic aorta below the stenosis so as to maintain normal or nearly normal diastolic pressure. Thus a normal diastolic pressure with low pulse pressure in the legs as seen clinically in patients with coarctation is easily explained without assuming that there is essentially a disturbance of renal hemodynamics. It is, however, possible that the renal factor may be superadded in some cases of coarctation as many patients of coarctation show decreased effective renal plasma flow and normal glomerular filtration rate as shown by Freidman, Selzer and Roseb'um (102) and Genest and associates (138).

7. Measurement of Heat Values of Food in Indian Weights.

Dr. G. B. Das, Calcutta.

For the Propagation of Scientific Knowledge of Nutrition among the Common People of India as advised by the League of Nations (Now defunct) & the UNO and to spread Scientific knowledge in the National language & weights :—

One Kilogram = 2.2046212 Pounds avordupoise (International).

One Seer = 2.0571428 „ „ (exactly) By Law of India.

$$\begin{array}{rcl} \text{One Kilogram} & 2.2046212 \text{ lbs.} & 1.07169091 \\ \text{Hence } \frac{\text{One Kilogram}}{\text{One Seer}} & = \frac{2.2046212 \text{ lbs.}}{2.0571428 \text{ lbs.}} & = \frac{1.07169091}{1} \end{array}$$

One Kilogram = 1.07169091 Seer

One Seer = 0.93310486 Kilogram (Scientifically established).

My definition, the quantity of heat that raises the temperature of one Seer of water to one degree (centigrade scale) is defined as one TAPATI.

$$\begin{array}{rcl} \text{Then } \frac{1 \text{ Calorie}}{1 \text{ Tapati}} & = & \frac{\text{Heat to 1 Kg. of water to 1 degree}}{\text{Heat to 1 Seer of water to 1 degree}} \\ & & \frac{\text{Heat to 1.07169091 seer of water to 1 degree}}{\text{Heat to 1 seer of water to 1 degree}} \\ & & \frac{1.07169091}{1} \end{array}$$

Hence 1 Calorie = 1.07169091 Tapati.

1 Tapati = 0.93310486 Calorie.

Now, 1 gram of Protein = 4.1 Calorie.

1 gram of Carbohydrate = 4.1 Calorie.

1 gram of Fat = 9.3 Calorie.

Ref: Text book of Physiology for Medical Students & Physicians by W. Howels, 7th Edition, Revised 1920, Page 960, Last line.

933.10486

1 Kancha weight being 1/64 the part of a Seer = $\frac{933.10486}{64}$ gm. = 14.57976 grams.

Therefore, *Heat value of 1 Kancha of Protein*

$$= 14.57976 \times 4.1 \text{ Calorie} = 14.57976 \times 4.1 \times 1.0716909 \text{ Tapati}$$

$$= 64.062486 = 64 \text{ Tapati (8}^2 \text{ Tapati)}$$

Heat value of 1 Kancha of Carbohydrate

$$= 14.57976 \times 4.1 \times 1.07169091 \text{ Tapati} = 64 \text{ Tapati (8}^2 \text{ Tapati)}$$

Heat value of 1 Kancha of Fat

$$= 14.57976 \times 9.3 \times 1.07169091 \text{ Tapati} = 145.306517 \text{ Tapati.}$$

allowing 7 % cut in the above value, we have

$$= 144 \text{ Tapati (12}^2 \text{ Tapati.)}$$

These basic values when applied to analytical table of food give one immediate heat values for particular food. The analytical Table should be based on percentage basis and the figure below the head of Protein, Carbohydrate & Fat are not, therefore, the quantity of the same. The Protein content of the food per Kancha can be calculated by dividing figure under protein by 100 or simply by shifting of the decimal by two places towards the left. Then by multiplying this quantity by 64 Tapati, we get the corresponding Tapati (heat value) of the Protein content of the food per Kancha.

In this way we can get the corresponding Tapati of Carbohydrate, or fat content of the food per Kancha by multiplying 64, or 144 Tapati respectively. By addition we can get the total Tapati (heat value) of one Kancha of food, If analysis is correct the total Tapati per Kancha of food will almost tally with the heat value derived by burning the food in Bomb Calorimeter. Now we can easily measure the heat value of any quantity of food in our own weight and that of Proteins carbohydrate or Fat separately by this method.

Section X///: ENGINEERING.

1. Hydrometeorology of the Damodar Catchment.

S. K. PRAMANIK and K. N. RAO.

ABSTRACT—A detailed study of the Hydrometeorology of the Damodar Catchment has been made.

1. The distributions of rainfall and rainy days during June to September and June to October are normal.

The chief results are as follows :—

2. The mean rainfall of the catchment has not been appreciably affected by the variations in the number of rain gauge stations.

3. The maximum probable rainfall in the catchment in one to seven days is :—

Days	Inches.	Days	Inches.
1	7.5	5	17.0
2	12.0	6	17.5
3	14.0	7	18.0
4	16.0		

4. A daily average discharge of 10,00000 cusecs is likely to be exceeded once in about 850 years.

5. High discharge at Rhondia (exceeding 20000 cusecs) on any date is very highly correlated with the rainfall recorded on the date and the preceding two days. This is also true of peak discharges in each year.

6. The regression formula between rainfall of July to October with the corresponding seasonal flow expressed in inches is :

$$D = 0.65 R - 8.68$$

Using this formula discharges have been computed from 1891 to 1950. The highest and lowest discharges during July to Oct. according to this formula are :

Highest 1917 = 5621200 cusecs or 11148800 Acre feet.

Lowest 1918 = 1794460 cusecs or 3559040 Acre feet.

7. The influence of temperatures on monsoon seasonal run-off is not significant.

8. Discharge of the Damodar river at Rhondia on any day is very highly correlated with the following :—

Rainfall of preceding day (.73)

Rainfall of preceding two days (.80).

Rainfall of preceding day and discharge of preceding day (.82).

2. New Developments in the Fischer-Tropsch-Synthesis.

WEIN GAERTNER.

In this paper I want to give a summary of the development which has taken place within recent years in the field of fundamental knowledge of the Fischer-Tropsch synthesis reactions together with a short discussion of the advances in the technical field.

During the first few years of utilization of the Fischer-Tropsch-synthesis, the technical development was far in advance over the theoretical knowledge of the reaction. But within the last years quite a good number of papers have been published, dealing with the further exploration of the fundamental steps of the synthesis reaction which makes it worthwhile to report on them. The number of these papers also indicates the special interest which is developed for this subject. In fact such fundamental research work has now become necessary more than formerly as it is felt more and more difficult to obtain progress through empirical methods only.

The Carbide Theory of Fischer and Tropsch.

Earlier to the discovery of the Fischer-Tropsch reaction the apprehension was existing according to Sabatiers work and to the Methanol-Synthesis that with the hydrogenation of CO, oxygen-containing compounds are formed and the formation of methane as pure hydrocarbon was only possible. This seemed further to be confirmed by the earlier Fischer-Synthesis, the "Synthol"-synthesis, which produced mixtures of hydrocarbons and alcohols with a primitive alkalized Fe-catalyst under pressure in 1922. Later the historical finding was made that with lowering of the pressure more and more hydrocarbons were formed. From then on, emphasis was laid on the development of liquid hydrocarbons, on account of the importance of these compounds in those days. Soon it was found that catalysts had to be developed which can work under lower temperatures at normal pressure, and in the absence of practically any detailed theoretical ideas about the true mechanism of the process, catalysts with sufficient activities had to be found by very troublesome and purely empirical methods. In 1932 Fischer and Koch finally produced the highly active Co-Cu-ThO₂-Kieselgur-catalyst by which the synthesis could be carried on an industrial scale. Table No. 1 shows the development at this early period of work.

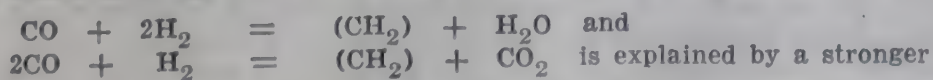
Fischer gave also the first theoretical explanation for a possible reaction mechanism which was called at that time the "Carbide-theory" and was generally accepted as that. It seemed to be obvious that metal-carbides, formed during the reaction, should be the intermediate products of the reaction as all the metallic catalysts used are able to form such carbides quite easily and actually the presence of such carbides in the Catalyst during the reaction could be verified by several workers like Bahr and Jessen and Gluud. Their formation had also been confirmed through the investigation of the treatment of Fe, Co and Ni with CO. The difficulty which arose from the fact that hydrogenation of such carbides should mainly result in the formation of Methane and that normally such carbides can not be reduced again into metal under synthesis conditions, Finally this led to the idea that such carbides were specially rich in carbon, like so-called "per-carbides" from which longer carbon-chains might be separated and hydrogenated, thus forming straight-chained hydrocarbons.

Table No. 1. First development of the Fischer-Tropsch-Synthesis up to 1932,

No.	Authors.	Results.
1	Sabatiers & Senderens, 1902	Methane-synthesis with Co- and Ni-catalysts from CO and H ₂ and CO ₂ and H ₂ , at normal pressure and up to 400°C.
2	B.A.S.F., 1913	Formation of hydrocarbons and O ₂ -containing compounds from H ₂ and CO at 100 atm, and 300-420°C with Fe, Co, Ni, Mn, Cr, Ti, Os, Pd-catalysts.
3	Fischer & Tropsch 1922.	Synthol-synthesis. Formation of alcohols, ketones, aldehydes and acids from CO + H ₂ at 100 atm, and 400°C with alkalized Fe-shavings.
4	Fischer & Tropsch. 1925.	Hydrocarbon-synthesis under normal pressure from CO + H ₂ at 180 — 240°C with Fe, Co and Ni-catalysts.
5	Fischer & Tropsch, 1932.	Highly active Co-Cu-ThO ₂ -Kieselgur-catalyst for the normal pressure operation of hydrocarbons from CO + H ₂ .

The intermediate formation of metal-hydrides and carbonates were also put forward for the time being. Later however, these theories had altogether been abandoned again. In general Fischer did not agree to any proposal in which the intermediate formation of O₂-containing compounds were suggested. A strict difference was made between the hydrogenation of CO under high pressure in the presence of oxide-catalysts which led to formation of alcohols etc. and that of the pure hydrocarbons formation in the presence of metal catalysts under low pressure.

The well known difference between the Co-and Ni-catalysts in one hand, which carry the O of the CO by forming water, and the Fe-catalysts on the other hand, which carry the O of the CO with the formation of CO₂ according to



activation of the CO-molecule on the Fe-surface at a higher temperature by which CO₂ is formed preferably, while on a Co or Ni-surface H₂ is more activated than

CO and thus accepts the oxygen. The Cu-content of the catalyst was regarded necessary as an oxygen accepting agent.

activated than CO and thus accepts the oxygen. The Cu-content of the catalyst was regarded necessary as an oxygen accepting agent.

This represents in short terms the fundamental ideas of the carbide-theory which is summarized in Table No. 2.

Table No. 2. Development of the Carbide-Theory up to 1932.

No.	Authors.	Results.
1	Fischer & Tropsch, 1926.	Alternate effect between metal and carbide $\text{Me} + \text{CO} + \text{H}_2 = \text{MeC} + \text{H}_2\text{O}$ $\text{MeC} + \text{H}_2 = \text{Me} + (\text{CH}_2)$.
2	Fischer & Tropsch, 1926.	Existence of labile carbides of high C-contents, 3—4 C-atoms per metal-atom. Extraction of these carbon-chains by H_2 . Rate of polymerisation of radicals (CH_2) and others higher than rate of hydrogenation.
3	Bahr, Bahr & Jessen, 1928-1933.	CO-splitting in présence of Fe, Co and Ni. Confirmation of existence of carbides of these metals in spent catalysts.
4	Fischer, 1930.	Alternating réactions between higher and lower grades of carbides according to $\text{MeC}_n + \text{H}_2 = \text{MeC}_n + (\text{CH}_2)$, $\text{MeC}_n + \text{CO} + \text{H}_2 = \text{MeC}_n + \text{H}_2\text{O}$.
5	Fischer & Tropsch, 1930.	Hydrides- and carbonyles-formation possible. No alcohols or aldehydes as intermediate products considered.
6	Fischer, 1930.	Carbide-formation according to : $2 \text{ Me} + \text{CO} = \text{MeC} + \text{MeO}$, reaction of Cu according to $\text{Me} + \text{Cu} + \text{CO} = \text{MeC} + \text{CuO}$.
7	Fischer & Koch, 1930.	Difference between Fe and Co according to : $\text{Fe} + 2 \text{ CO} = \text{FeC} + \text{CO}_2$ (210 — 270°C) $\text{Co} + \text{CO} + \text{H}_2 = \text{CoC} + \text{H}_2\text{O}$ (170 — 210°C).*
8	Fischer & Koch, 1932.	Hydrides and carbonyles not likely to be present, higher carbides not necessarily existing. Hydrogenation of carbides to CH , CH_2 and CH_3 -radicals. Polymerization of these radicals to hydrocarbons suggested.

The first series of papers published on this subject outside Germany did not however, appear earlier than 1939. Craxford suggested a high concentration of carbides on the catalyst surface for the formation of higher hydrocarbons. The remaining metallic surface then favours the formation of atomar H_2 which leads to the formation of methane instead of oil. He observed that with pure CO the formation of carbides was relatively slow and hence suggested that it might be faster in the presence of hydrogen. Many workers agreed to this theory of Craxford

-
- 3 Herington & Woodward, 1939. Agreement with Craxford's theory. CH_4 -forms on the metal surface, and the oil-formation being catalysed by carbides.
-
- 4 Komarewsky, 1939. Twofold action of the catalyst. Ni, Co and Fe hydrogenates to CH_2 , while Th, Si, Mg, Al activate the CH_2 -polym.
-
- 5 Jerofejew 1940. Proposes a formula for contraction and production-time for the catalyst in accordance with Carbides-formation.
-
- 6 Eldus & Zelinsky, 1942. Rate of carbide formation with Co-catalysts in the presence of H_2 is higher than the hydrogenation of carbon. In agreement with Craxford's ideas.
-
- 7 Pichler, 1943. Hydrogenation of CO_2 into CH_4 is not connected with Carbide-formation but is achieved by the activated H_2 . Formation of hydrocarbons from CO_2 follows the primary reduction of CO_2 to CO.
-
- 8 Flischer, 1943. Renewed confirmation of the carbide theory.
-
- 9 Craxford, 1946. ThO_2 and Kieselgur accelerate the carbide formation which must be higher than the hydrogenation of carbides.
-
- 10 Craxford, 1946. Formation of oil only possible with the help of carbides in the first layer of the catalyst. In the lower layers
 • CO-conversion takes place : $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$.
-
- 11 Craxford, 1947. Co forms silicates in presence of Kieselgur. Normal Co-carbides do not play any role, but they act only in presence of the silicates if they have similar structure.
-
- 12 Anderson, 1948. N_2 -and CO-adsorption measurements with Co-catalysts with or without promoting agents. Agrees with Craxford's theory.
-
- 13 Riess, 1948. Co-catalysts possess a bifunctional effect : Activation agents act as polymerizing promoters.
-
- 14 Eldus, 1948. Synthesis-reaction is supposed to take its way over carbides in the case of Fe-catalysts but not with Co- and Ni-catalysts.
-
- 15 Braude & Bruns, 1948. Doubts in Eldus views are raised in the light of the results of the rates of reactions.
-

surface. According to Broetz the CH_2 -polymerization is an addition of CH_2 -radicals through the exchange of $\text{CH}_2 = \text{CO H}_2$ with the catalyst surface. Warner expects

in spite of the fact that it contained several contradictions. Fischer had also stressed equally the difference between the mechanism of the CH_4 -formation with that of the formation of the higher hydrocarbons. Authors like Herington and Woodward, Jerofejew, Eidus and Zelinsky were of the same opinion with Craxford's theory. Further researches of Craxford deal with the role of the promotive substances and the Kieselgur in the catalyst. He believes that Co-silicates are existing which favour the formation of Co-carbides having the same structure as the silicates. On the other hand the silicate formation with Thoria and Magnesia is supposed to facilitate the different intermediate reactions which lead to the alternate formation and removal of such carbides. The well known result that the oil yield is decreased while the CO_2 -formation increases with lower throughput of synthesis gas, is explained by the assumption that formation of oil occurs within the first layer of the catalyst due to heavy carbide formation while the lower layers of the catalyst bed which are still free from carbides rather favour the water-gas reaction by which CO_2 is produced.

This conception however has later been refuted by experimental results of Koelbel and coworkers.

Already Matsumara, Anderson, Krieg and Friedel do not however agree with Craxford's system. Komarewsky attributes a bifunctional effect to the catalyst: The CH_2 -formation should take place on the Co-metal-surface, while the activating components like Thoria etc. catalyse the polymerization of the radicals.

All these observations which are partly of recent origin are more or less modifications of Fischer's carbide theory. Fischer has acknowledged himself anew to the carbide theory in one of his last speeches. All these many works which are summarized in the Table No. 3 finally indicate the uncertainty of this suggestion.

Formation of chained hydrocarbons.

Only very little convincing experimental data are known as yet about the mechanism of the polymerization process of the primarily formed CH_2 - or other radicals. Fischer claims a higher rate of polymerization than of hydrogenation only in order to avoid the early breakage of the chain reactions. Craxford thinks that long chains of hydrocarbons are formed originally on the surface of the catalyst with the help of carbides which are rich in carbon content. Under the influence of atomic H_2 and by cracking of these long chains they are disintegrated into smaller ones which then evaporate from the surface. The presence of atomic H_2 prevents finally the formation of very high molecular hydrocarbons. Hall seems to be of the same opinion. Matsumara opines that the extent of CH_2 -polymerization depends on the rate of desorption of the hydrocarbons from the catalyst.

Table No. 3. Summary of Work of the Carbide Theory 1939 — 1948,

No.	Authors.	Results.
1	Craxford 1939.	Atomic H_2 is responsible for CH_4 -formation and CO-conversion on the Co-metal-surface. Formation of oil is possible only in presence of carbides without the action of atomic H_2 .
2	Fischer & Pichler 1939.	Generally in accordance with Craxford. The CH_4 -formation follows a different mechanism than the formation of the oil.

Ketenes to be formed as intermediate products from CO and H_2 which may either be converted into hydrocarbons or into oxygen-containing compounds. All these correlations are not very satisfactory. The combination of CH_2 -radicals into longer chains in the process of saturation with free affinities than to Ethylene in the presence of H_2 is not easily understandable. Ziegler has shown that organic radicals can easily polymerise Ethylene in starting a chain reaction. Presence of Ethylene and radicals during the Fischer-Tropsch-synthesis is realized. Thus a chain reaction of Ethylene polymerization is quite possible. Also the production of mostly α -olefines leads to the supposition that such a type of reaction is obvious. This would mean that the formation of higher hydrocarbons is due to Ethylene polymerization. Recently Beeck could make sure that CH_3 -radicals are formed in the synthesis reaction and that polymerization reactions with olefines take place. Also Anderson and co-workers are of this opinion in support of their findings.

Koelbel and co-workers have shown that propylene and butylene, when added to the reaction, can be included in the built-up-process of higher hydrocarbons. Even higher saturated hydrocarbons themselves can take part in such a process. Prettre and Craxford have found that CH_4 can also be introduced in the polymerization process. Koch and Gilfert have stated that in the presence of H_2 with the help of a co-catalyst hydrocarbons can be transformed into the next higher products as well as cracked to smaller compounds. Radical formation can also serve towards explaining these findings. *Table No. 4* shows a short review of these developments.

Investigations in conditions of catalyst-composition and surfaces.

It is essential therefore to gather further knowledge of the process regarding the physical and chemical conditions of the different catalyst. Not much work has been done so far on this subject, specially with the Co-catalyst, while more investigations have become known for the Fe-catalyst. Gluud, Bahr and Bahr were the first to ascertain the formation of carbides during the synthesis reaction. A number of French workers state that special Fe-oxydes and Ferites represent the active substances. Carbides are not to be considered as being present. Koelbel and co-workers found Fe_3C , Fe_2C and Fe_3O_4 in the catalysts used but no metallic Fe or no Ferites. Fe_2O_3 and α - Fe_2O_3 were also not found. The formation of carbides depends on the composition of the catalyst as well as on the working conditions. A labile carbide was found existing during the formation period of the catalyst with a Curie-point at $220^\circ C$. It remains stable only up to $290^\circ C$. With progressing time and temperature it becomes stabilized and other carbide appears with a Curie point between those of Fe_2C and Fe_3C . Even the labile carbide could not be reduced by H_2 -treatment under synthesis reaction conditions. This indicates that the carbides may not play a decisive role at intermediate stages of the reaction. Pichler and Merckel have found practically the same results. Fe_2C could also be found by Scheuermann and Halle. Several other authors studied the decomposition of CO on the catalyst surface and found that carbides have no part to play in the reactions. Hofer and Peebles could not find any carbides in the catalysts used by X-ray-analysis, though they were present. This indicates that these carbides may only be formed on the surface. Co_2C which has been produced by decomposition of CO can not be changed under synthesis conditions. Well defined and stable Co-carbides are neither formed nor reduced during the synthesis reaction. From all of these and many other researches it has been derived that the search for active substances on the catalyst surface has brought no definite success so far and led to much contradictory results.

These investigations have indeed led to many doubts about the accuracy of the carbide theory. Moreover this theory has further been unable to explain the mechanisms which must exist in other forms of the CO-hydrogenation like Iso-synthesis, methanol-synthesis and Oxo-synthesis. **Table No. 5** summarizes the said investigations.

Other Co-hydrogenation processes.

The methanole-synthesis of the B.A.S.F, with $\text{ZnO-Cr}_2\text{O}_3$ -catalysts and the Synthol-synthesis of Fischer, as is well known, produce oxygen-containing Compounds. Fischer thought that under pressure in such cases a special activation of H_2 took place and this idea was always accepted and followed by him in all cases where oxygen-containing compounds are formed and it was strongly kept separate from the hydrocarbon-synthesis. Later, this explanation of Fischer had been modified by him after the discovery of the medium pressure synthesis as O_2 -containing substances formed in that reaction should be produced on the oxide-surfaces of the catalyst. Fischer and Pichler carried out the CO-hydrogenation with Ruthenium-catalysts into higher hydrocarbons in 1938. The Ru-catalyst far surpassed the usual Co-catalysts both by its activity and stability. But no Ru-carbides have become known to be existing, as yet. Therefore it is rather difficult to explain the Ru-synthesis by Fischer's theory. The same difficulty exists with the Iso-synthesis which has been found by Fischer, Pichler and Ziesecke in

Table No. 4. Theories of the reaction mechanism during the formation of higher hydrocarbons.

No.	Authors.	Results.
1	Fischer, 1926.	Polymerization of CH_2 -radicals. Polymerization is faster than hydrogenation to CH_4 .
2	Fischer & Koch, 1932.	Equilibrium between polymerization and depolymerization suggested.
3	Craford, 1939.	Desorption of long chains from the catalyst surface.
4	Komarewsky 1939. Riess 1948.	Polymerization effected by ThO_2 , Si, Mg, Al.
5	Broetz, 1949.	Straining of CH_2 -radicals with simultaneous H_2 exchange all over the catalyst surface.
6	Warner & Co-workers 1946.	Ketenes as intermediate products in the formation of hydrocarbons and oxygen-containing compounds.
7	Koelbel & Ruschenburg 1937	Possibility of enlargement of chains of lower olefines.
8	Koelbel & Ackermann 1943.	Enlargements of chains of higher olefines and paraffines during synthesis reaction.
9	Koelbel & Engelhardt 1949.	Possibility of radical-chain-reaction and its mechanism according to Ziegler's suggestion discussed.
10	Prettre 1947.	Participation of CH_4 in the building up of chains.

Table No. 5. Catalyst—examination,

No.	Authors.	Results.
1	Gluud, 1929.	Preparation of Fe-carbides and Ni-carbides with CO at low temperatures.
2	Anthe'aume 1934.	In active catalysts only Fe_3O_4 exists. Little activity with more distinct x-ray interferences. No carbide formation discussed.
3	Michel & Chaudron 1935.	Fixed solutions of K-ferites in Fe_2O_3 as active substances suggested. Carbide formation not discussed.
4	Lefebvre & Le Clerc, 1936.	Cubical $\gamma\text{-Fe}_2\text{O}_3$ is active substance, partly stabilized by K-ferites, carbide formation discussed.
5	Koelbel, Juza & Co-workers, 1949.	In catalysts used Fe_3O_4 , Fe_3C , Fe_2C are identified. No metallic Fe found. Thermically unstable carbide found within the first working period, also in inactive cat.
6	Scheuermann 1948.	Demonstration of existence of Fe_2C in Fe-catalysts, hexagonal structure.
7	Hedvall & sandford, 1935.	CO-decomposition with Ni, which changes its rate in the neighbourhood of the Curie point. Carbides have no importance.
8	Olmer, 1942.	CO-decomposition is possible with Fe, Co and Ni-Carbides and have no influence on the reaction.

1942. In this synthesis metal catalyst is no more used at all but ThO_2 and Al_2C_3 only. At pressures up to about 600 atm. and temperatures of about 450°C preferably side chained hydrocarbons are formed. This reaction mechanism may be explained by the existence of alcohols as intermediate products, which by hydration are converted into iso-paraffines and olefines. The Oxo-synthesis which had been found in 1938 has been explained with the existence of intermediate carbonyl-hydrogen-compounds. *Table No. 6* shows all these different findings summarized,

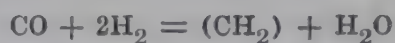
From all of these results we may state that the Carbide Theory is not the universal one but is particularly valid for a very limited and specific use out of all the many different possibilities. Nevertheless it seems unnecessary that for each synthesis a special reaction mechanism exists and would separately be found out, but there might be existing still a general mechanism and the products of which may be different only due to the different reaction conditions of each synthesis. Therefore it seems to be worthwhile to search for this general principle carefully.

Other Explanations for the synthesis reaction.

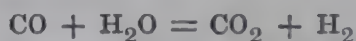
Elvins and Nash in 1926 suggested that oxygen containing intermediates played an important role. Later they supposed that carbonyles form the inter-

mediates. Smith, Hawk and Golden observed that the formation of oxygen-compounds are possible when they incorporate Ethylene to the synthesis reaction. They think the following mechanism probable : CO and H_2 form a complex on the surface which occasionally decomposes into olefines and H_2O . The olefines interact again with the complex and form an oxygen-containing compound which may appear as such according to the reaction conditions or may decompose into higher olefines with the formation of water. Some of the olefines then become hydrogenated.

Many authors accepted this theory of Smith, as Eidus did in 1945 although he had expressed a different view formerly, and Hall has accepted it recently. Koelbel and his co-workers probably have given the most universal explanation which may be called the "Chemisorption-Theory," due to their most interesting finding that the formation of CO_2 with Fe-catalysts is only a secondary reaction. They could show also that the primary step of the reaction is the same as in presence of a Co-catalyst :



But due to the higher temperature of the Fe-catalyst, the water gas reaction is much more favoured which is also possible in the presence of a Co-catalyst only in case the latter works at higher temperatures. And hence this is rarely observed due to the lower temperature of working of this catalyst in general. Thus CO_2 is formed according to



Along with the primarily formed H_2O . In the presence of a Co-catalyst rich in carbides at $180^\circ C$ the reaction could be forced to take its way totally to the direction of CO_2 -formation while a high oil yield was obtained, and exactly the reverse phenomenon took place with an Fe-catalyst which could be run with 80 % H_2O -formation. They found from their experiments quite clearly that the presence of carbides was not necessary to interfere in the synthesis reaction. For both cases, of synthesis reaction as well, as for carbides-formation, an activation of CO was required. With regard to the activity of the catalyst in the formation of carbides, its activity for the synthesis reaction should increase in the direction from Ni to Co to Fe. But obviously this is not the case. It was however found on the contrary that the higher tendency of the Fe-catalysts in the formation of carbides is only disadvantageous with respect to the activity of the catalyst towards the synthesis reaction. The existence of the carbides seems to have the only desired quality to avoid the too high activation of H_2 by which hydrogenation and CH_4 -formation is lowered. Synthesis-catalysts obviously reach their highest activity when they are converted into the metallic state, almost free from carbides. Under these conditions the methane-formation is greatly favoured at the same time. The CH_2 -formation and polymerization of radicals require a lower H_2 -activation which will be achieved by a quick formation of carbides. These carbides are not only found on the surface of the catalysts but also more in the interior portions, while all the synthesis reactions are going on within the surface area.

CO and H_2 are actively adsorbed on the surface of the catalyst while forming an indefinite compound with the atoms of the latter as a first step of the reaction. No detailed acceptance of any defined carbides is required. These may also be formed simultaneously but are not considered as intermediate products. The adducts of H_2 and CO on the surface become very active due to their high activation energy. The next step then consists in the decomposition of the adducts with a continuous regeneration of the active surface at the same time. According to

different reaction conditions and catalysts, different paths are open for the specific type of decomposition and further reactions. These are represented in more details in *Table No. 7*. When the C—O linkage is broken, then hydrocarbons are formed exclusively. We get the system of the hydrocarbon-synthesis.

When the C—O linkage remains, then oxygen containing compounds will be the result. These may release H_2O and form olefines. No presence of CH_2 -radicals is then necessary.

Also the formation of CH_4 can be explained by the existence of atomic Hydrogen. In the presence of ethylene which may be formed by dimerization of CH_2 -radicals, a chain polymerization reaction to build up high olefines, may be expected. In the same way higher alcohols may also be formed. In this manner, all the different paths of the CO-hydrogenation can be explained without difficulty while this is not possible with the carbide theory.

The major conditions for a good catalyst according to the Chemisorption theory are then the following :

H_2 and CO must be actively adsorbed on the surface and thus become activated. The surface must be prepared accordingly. A definite ratio between activated H_2 and CO must be maintained. High temperature and high partial

Table No. 6. Other process of Co-hydrogenation.

No.	Authors.	Results.
1	Fischer & Tropsch, 1922.	Synthol-process, 100 atm, 400°C, alkalized Fe-shavings O_2 -containing compounds. Activated H_2 causes association of $CO + H_2$ to formaldehyde.
2	B.A.S.F., 1923.	Methanole-synthesis, 200 — 400 atm, 300 — 350°C, $ZnO-Cr_2O_3$ -catalyst without any Fe.
3	Smith and Co-workers 1930.	Addition of $CO + H_2$ to ethylene in the formation of O_2 -containing compounds. Association of Co and H_2 . Decomposition of the complex into olefines and H_2O . Adsorption of olefines on the complex with partly reduction of the olefines into paraffines.
4	Fischer & Pichler 1938.	Paraffine-synthesis with Ruthenium-catalyst. Carbonyl as an intermediate product are taken into consideration.
5	Roelenr 1938.	Oxo-synthesis. Addition of CO and H_2 to olefines with the formation of aldehydes and its derivatives, Co-catalyst > 100 atm., 150°C. Intermediate formation of carbonyl hydrogen,
6	Pichler & Ziesecke, 1943.	Iso-synthesis : CO-high pressure-hydrogenation at 500 to 600 atm, 450°C with ThO_2 -catalyst with Al_2O_3 and ZnO activators. Intermediate existence of alcohols, secondary dehydration into iso-hydrocarbons,

Table No. 7. Reaction mechanism of the Co-hydrogenation according to Koelbel's "Chemisorption Theory."

No.	Authors Principle	Mechanism.	Results.	Intermediates.
1	Chemisorption at the catalyst surface of $H_2 + CO$.	$Cat. + CO = Cat. CO$ $2 Cat. + 2 H_2 = 2 Cat. H_2$	CO-adduct H_2 -adduct	
2	Hydrocarbon-Synthesis.	$Cat. CO = Cat. O + C^\circ$ $Cat. H_2 + C^\circ = Cat. + CH_2$ $Cat. H_2 + Cat. O = 2 Cat + H_2O$ $Cat. + C^\circ = Cat. C.$	CO-splitting C-hydrogenation. Catalyst-Regeneration Carbide-formation. Side-reaction,	
3	Synthesis of O_2 -containing Compounds.	$Cat. CO + Cat. H_2 = 2 Cat. + CH_2O.$	Formaldehyde-formation.	
4	Methane-formation.	$Cat. H_2 = Cat. + 2 H^\circ$ $CH_2 + 2 H^\circ = CH_4$	Atomar H_2 -format. CH_2 -hydrogenation.	
5	Hydrocarbon composition to higher molecules,	$2 CH_2 = CH_2 = CH_2$ $R + CH_2 = CH_2 = R-CH_2$ $-CH_2-R-(CH_2-CH_2)_n =$ $R-CH_2-CH_2)_n-R.$	Ethylene-formation from CH_2 . Radicals chain reactions of Ethylene.	
6	Built up of O_2 containing hydrocarbons Oxo-synthesis.	$R-CO + CH_2 = CH_2 = R-CO-CH_2-CH_2 = R-CO-CH_2-CH_2-R$ $R-CH = CH_2 + CO + H_2 =$ $R-CH_2-CH_2-CH_2-COH.$	Ethylene-addition to aldehydes with Radicals. Oxo-reaction.	

pressure of H_2 work in favour of higher H_2 -activation. Carbides may act as negative catalysts for a too high hydrogen activation. Higher CO partial pressure favours CO-activation.

The formation of highly active metallic state of the catalyst seems to be the main objective in so far as high catalyst activity and stability are concerned. Carbides and some Oxydes like Magnetite may work in the same way as they have the similar structures which do not disturb the metallic condition. By this the excellent activity of the Ruthenium-catalyst can be explained, the metallic condition of which is neither disturbed by Oxides nor by Carbides. Reaction conditions must be strengthened obviously in going over to higher temperatures and pressures in the same proportion as the metallic surface is being replaced by oxides as in the methanole- and the Iso-synthesis. When catalysts like ZnO , ThO_2 , Cr_2O_3 etc. are used, pressure and temperature must be increased considerably.

Several recent publications are likely to give more support to this theory. The strongest argument against the Carbide-theory in favour of Koelbel's theory has been the contribution of Kummer, De Witt and Emmett, who could show with the help of ^{14}C -Isotope that with a Co-catalyst at $200^\circ C$ and with a Fe-catalyst at $260^\circ C$ only 10 % of the hydrocarbons are formed with carbides as intermediate stages. Equilibrium-calculations make it further obvious that with the reduction

of Fe_2C with H_2 at 10 atm. and temperatures of 227 — 327°C only minor amounts of olefines can be formed, and neither the reduction of Fe_2C nor Fe_3C represents the real intermediate product for the hydrogenation formation.

The final explanation of the complicated CO-Hydrogenation reaction is not yet established definitely. But the new theory may be regarded as an attempt to give a better understanding than the Carbide-theory has been able to provide.

Technical developments.

Finally I have to report on some interesting technical developments in the field of the Fischer-Tropsch-Synthesis. One of the main tasks since the installation of big plants has always been to improve the space time yield of the catalysts in use which was originally only of the dimension of 8—10 kg liquid hydrocarbons per 1 m³ catalyst space per hour in the old German plants. This yield could be increased gradually as a consequence of several improvements of the process, which formerly was carried out in a 2 — 3 stage fixed bed catalyst system through which synthesis gas was passed. These improvements were :

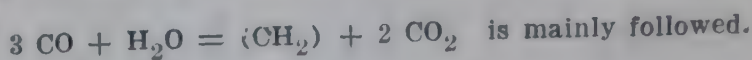
1. Use of higher gas pressure than normal pressure,
2. Use of a gas recycle system with gas of lower concentration but at considerably higher velocity of flow,
3. Use of a synthesis system to carry out the synthesis in the presence of oil in order to improve the heat exchange and to avoid superheating of the catalyst,
4. Use of the fluidized catalyst system, that means the use of a floating catalyst bed,
5. Use of high catalyst layers with high gas velocity and with increased catalyst temperature towards the end of the layer.

All these methods attempt to improve the utilization of the catalyst mainly with respect to the exchange of heat of reaction. The space time yield could finally be raised to 50 — 60 kg of products per 1 m³ catalyst space per hour. It was known earlier that the reaction in the old converters took place practically only in the upper part of the catalyst layer near the entrance of the gas while the lower part was not properly utilized, as is seen in the *Figure No. 1*. By bringing down the $\text{CO} + \text{H}_2$ -concentration and by increasing the rate of gas flow, these conditions could be greatly improved and the heat of reaction could be removed more easily. In the fixed bed layer, heat could be removed still more favourably by using oil as a medium of interchange. Also a suspension of the catalyst in the oil while synthesis gas was bubbled through it, is very successful. The use of the fluidized catalyst bed has then proved very successful for heat exchange and higher catalyst efficiency. But it is necessary at the same time to avoid the formation of higher hydrocarbons and waxes, as these products inhibit the desired reactions and products by forming a paste of catalyst powder and paraffin waxes,

The long layer-fixed-bed-system with high gas velocity and increase of catalyst temperature in the lower layers as is indicated by *Figure No. 2*, has also proved successful to such an extent that this development competes with that of the fluidized system,

Recently Koelbel claimed to have been able to produce hydrocarbons and

O₂-containing compounds from CO and H₂O mixtures by using such catalysts which favour the water gas reaction at the same time. By this reaction, part of the CO is converted into H₂ which then can further react with CO to hydrocarbons or oxygen-bearing hydrocarbons according to pressure and temperature. The reaction



This method may be useful in utilizing blast furnace gases or other CO-containing gases towards the production of organic compounds.

The Fischer-Tropsch-Synthesis has become mainly a source for the production of hydrocarbons and other valuable organic materials, like olefines, alcohols, acids etc., which can be synthesized directly from coal. The process, if carried out in a not too small scale, is highly economic in all countries where low grade coals are available and where coal is cheap. It can further be used for the conversion of all such CO-containing gases which are not yet properly utilized, into valuable products. In a large scale it can be experienced with the conversion of natural gases into liquid fuel as it is intended now in the USA.

standstill and many progresses may still be expected in the near future.

The development of this very much interesting subject has not yet come to a

2. Iron and Steel Industry in India.

J. McCHACKEN and M. S. DOSHI.

The Indian Iron & Steel Co. Ltd., and The Steel Corporation of Bengal, Ltd., Burnpur.

Synopsis :

A brief sketch of the Iron & Steel Industry in pre-historic days has been reviewed followed by comparatively recent attempts to manufacture Iron in India on modern lines. Data of availability and quality of the principal raw materials required for this industry is given and a comparison made wherever possible with raw materials available in other parts of the world. An attempt has been made to bring out clearly specific inherent advantages and disadvantages of the indigenous raw materials over those obtained in other countries and how these have influenced the adoption of particular practices in India.

The subject of operation difficulties in the manufacture of iron and steel is touched and tentative solutions offered. The writers in the end conclude that in view of the very special nature of advantages that India possesses over other countries, she should plan her Iron & Steel Industry on much bigger scale than hitherto done and thus become one of the leading exporting countries of this commodity.

Historical :

While the information available regarding iron of ancient production is meagre, yet undoubtedly a high degree of skill and knowledge must have existed in India thousands years ago. This is evident from references to iron in India's ancient literatures and proved by the numerous archaeological remains. The

scarcity of copper and the abundance of iron in India makes it probable that with the Hindus the iron age was not preceded by a bronze age.

The great Alexander of Macedon was presented with a piece of steel by Porus an Indian Chief whose country he invaded. It can be hardly believed that a matter of 30 lbs. weight of steel would have been considered a present worthy of acceptance by the conqueror had the manufacture of that substance been practiced by any of the nations of the West in the days of Alexander. The claim of India to a discovery which has exercised more influence upon art conducing to civilization and the manufacturing industry than any other within the whole range of human invention is altogether unquestioned.

The wrought-iron pillar close to the Kutub near Delhi is some 1500 years old ;¹ the huge iron girders at Puri ; the ornamental gates of Somnath, the 24-feet wrought iron gun at Nurvar, the 43-feet Dhar Pillar in Malva are monuments of a bye-gone art and bear silent testimony to the metallurgical skill attained by the Hindus. It opens our eyes to an unsuspected state of affairs to find the Hindus at that age capable of forging a bar of iron larger than any that have been forged even in Europe up to a very late date, and not frequently even now. It is almost equally startling to find that after an exposure to wind and rain for 14 centuries, the Delhi Pillar is unruined, and the capital and inscription are as clear and as sharp now as when put up fourteen centuries ago. This suggests that resistance to corrosion is due to the surface condition of metal and this secret has still not been unearthed by the Scientists of to-day. Furthermore, it is noticed that there must have been a superior heat-treatment skill among the ancient Hindus.² Without this skill, it would not have been possible to manufacture the sword blades of Toledo, Bilbas and Damascus fame, which have never been excelled.

We shall now describe the somewhat comparatively recent attempts to manufacture iron in India on modern lines. In 1830. Mr, Joseph Marsall Heath formed a Company called the Indian Steel, Iron and Chrome Company at Bepur³ and Portonovo in Madras. There was a great demand for Indian steel in England at that time and Mr. Heath even obtained a Government subsidy for this purpose.

He was faced by numerous difficulties. His boiler burst and the blowing engines had then to be driven by bullocks.

In 1857 the Kumaon Iron Works were started, but were closed in 1864. In this case, the iron ore and charcoal had to be transported long distances over mountain paths by mules and goats, and in the rains the roads disappeared, also the ore and fuel.

In 1860, Works were put down at Burwal,⁴ Central India, but on the day the furnace was blown in, it cracked and threatened to wreck the tent, in which the inauguration banquet was being held. No more money was forthcoming to rebuild it and the Works closed. In 1875 a furnace was started at Warara to work the ore of Chanda district. This venture failed within a week, The iron formed was of spongy appearance, did not liquify, though the temperature was raised so high that even the refractory bricks and the bottom of the hearth were fused.

In 1880 the Raja of Sermur Nahan erected a charcoal blast furnace on the top of a mountain near his residence, and after getting the blowing engine, boilers, and other materials dragged up the mountain and erected, the furnace never was started. All the material, ore etc, had to be carried 14 miles by mule, and there was no water,

The Bengal Iron Company was formed in 1874 to work on the Ranigange ore deposits. But in 1879 the Company ceased to operate, the cause of failure being assigned as insufficient capital. The Works were again started some years later under the Government management. This is probably the first nationalised iron industry. After being put to successful operation this was sold to the Bengal Iron and Steel Company in 1889. In 1903 The Bengal Iron and Steel Company decided to erect a steel plant. The steel furnaces came into operation in 1905, but were shut down after less than a year's working. In 1936, this Company passed on to the Indian Iron and Steel Company Limited.

The Tata Iron & Steel Works, located in the district of Singhbhum, Bihar, was formed in 1907, first pig iron was made in 1912. The original plant consisted of two blast furnaces and a steel plant with a capacity of 120,000 tons of pig iron and 80,000 tons of steel. Numerous extensions to the plant have since been carried out.

The Indian Iron & Steel Company was started in 1918 at Hirapur, about 10 miles from Kulti in West Bengal. The Steel Corporation of Bengal Ltd. came into operation in 1939. The location of Steel Corporation Works within a short distance of the Works of The Indian Iron & Steel Co. Ltd. has worked to the Corporation not only with pig iron but also gas, power, water, etc.

The Mysore Iron and Steel Works at Bhadrabati was started in 1921. This particular place was chosen as the site of the factory on account of proximity to the iron ore mines, forests and a big perennial river. The blast furnace was first blown in 1923 and was the first modern charcoal blast furnace in India.

Availability and quality of Raw Materials :

The following is the list of principal raw materials required in the manufacture of iron and steel—

- (1) IRON ORE
- (2) COKING COAL
- (3) LIMESTONE
- (4) DOLOMITE
- (5) MANGANESE ORE
- (6) REFRACTORIES
 - (a) Firebricks
 - (b) Silica
 - (c) Magnesite
 - (d) Chrome ore

(1) *Iron Ore*: Quantitatively and qualitatively, India probably excels any others country in her resources of these ores. Recent prospecting has disclosed almost inexhaustible deposits of high grade iron ores, chiefly haematite. The important deposit is the Bihar-Orissa belt occurring in the Mayurbhanj state, south Singhbhum, Keonjhar and Bonai. India's two main primary producers draw on this source, which a recent estimate puts in excess of 8000 million tons. Typical analysis show iron contents of 60 to 68 per cent, with phosphorus as low as 0.03 per cent., but rising to 0.1 per cent. in some districts. These ores are conveniently worked by open quarrying. The Mysore Iron & Steel Works at Bhadrabati draws its ore from the haematite deposits in the Bababudan Hills close by, where resources are now estimated to be 150 million tons. Further deposits of high grade ore are in the Madhya Pradesh and Madras. Low grade iron ore (Fe, 45/50 per cent; is met with in almost all the provinces of India, and even to-day the aboriginals of Vindhya Pradesh are working these low grade deposits and manufacturing knives,

spears and swords for their own use. Typical analysis of iron ore available in Bihar-Orissa, Central Provinces and Mysore state are given below :

	Bihar-Orissa.	Madhya Pradesh (Jubbulpore area),	Mysore State.
SiO ₂	3. 0 %	1.43 %	2. 5 %
Fe.	62. 0 %	68. 0 %	58. 5 %
Al ₂ O ₃	4. 0 %	.24 %	5. 0 %
CaO	. 2 %	.10 %	. 1 %
MgO	Trace	Trace	Trace
S.	Trace	Trace	Trace
P.	03.1 %	.05 %	.05 %
Mn.	.06 %	.10 %	.04 %

Iron ore on the whole is very pure and is an excellent material as an oxygen supplier in steel smelting. Bihar-Orissa and Mysore State ore deposits have Alumina/Silica ratio higher than usually to be met with at other parts of the world. This high alumina input into the blast furnace from the gangue material of these ores and from coke results in very high alumina slags which are very poor desulphurisers and constitutes one of the greatest handicaps in operating blast furnace plants in India. The Madhya Pradesh deposits do not have this high alumina gangue material and they are probably the best iron ore deposits in India from the Blast Furnace operation point of view.

Though very good supplier of oxygen for the removal of impurities in the iron (in making steel), Indian ore appears to be less readily reactive ; it tends to lie dormant for some time at the bottom of the steel furnace and suddenly reacts at a later and inconvenient time. A side light on this action and its possible effect on hearth damage was seen when lumps of various materials were examined from the bottom of a furnace which had been taken off for repairs. Here a mass of ore had been reduced to Fe₃O₄ only and its nascent oxygen had so rapidly oxidised neighbouring metal (raising its melting point and thereby solidifying it), that the ore was completely enclosed and weighted down by a shell of practically pure iron. Thus it would be unable to continue its work until the envelope melted or burst when a sudden reaction would take place at the bottom.

(2) *Coking Coal*: India's coal mining is centred mainly in Bihar and West Bengal. The total reserve of coal down to a depth of 2000 ft. are estimated at 65,000 million tons of which good quality coal would amount to 5,000 million tons⁶. The reserves of coking coal, however, are small and would amount to only about 2,000 million tons⁶ and this may well be halved unless measure of conservation, notably stowing, blending and washing are enforced. The reserves of comparatively low ash coking coal contained in seams Nos. 18, 17, 15, 14, 14A and 12 JHARIA & the Laikdik and Ramnagar seams of Raniganj, is getting fast depleted and in future increased dependence will have to be placed on reserves of coal in 16, 16A, 13, 11 & 10 seams with high ash content but with good cooking properties. The average ash content of these coals is approximately 20.5 % which excludes their direct utilization for making of blast furnace coke.⁷ On the whole, the Indian coking coal is much inferior to that normally used in other steel producing countries in the world on account of very high ash content (14-20 % instead of 5-10 %). Again, the high ash appears to be inherent in the coal and not due to simple admixture of foreign matter so that hand picking is not sufficient. As already alluded, the blast furnace slag derives approximately 50 % of its alumina from the alumina bearing coke ash. There is one more drawback with Indian coals. Majority of them are high phosphorus coals.

Low phosphorus coals are exceedingly rare in India and most of them have been exploited in the past for other purposes than those for which they are particularly suited, namely the making of ferro-manganese and Bessemer grade pig iron. An exception appears to be Laikdih coal from Raniganj. This coal contains phosphorus to the extent of 0.050 %.

The sulphur in Indian coal (with certain notable exceptions) averaging about 0.4 is comparatively low. This is a decided advantage because a lower sulphur coke is produced, hence a better chance of a low sulphur iron. This advantage compensates to some extent the dis-advantage resulting from its high ash content.

Coke from the Indian coal has very good physical properties, having shatter index plus 2" equal to 34/90 and porosity equal to 40. Further-more, Indian coals in general are free from harmful swelling propensities which might prohibit their use in coke ovens.

(3) *Limestone*: Supplies of limestone, required as a flux both in blast furnaces and in basic steel-making are obtained from Gangpur State, about 110 miles from the main producers. There are inexhaustible deposits of limestone fairly well distributed all over India. By far the largest limestone deposits are high in SiO_2 . Typical analysis of limestone is given below:—

SiO_2	Al_2O_3	Fe.	S.	P.	CaO	MgO.
5 %	2.5	.3	Trace	Trace	48 %	3.5

(4) *Dolomite*: There are extensive deposits of this material in India. Raw Indian Dolomite, like raw Indian Magnesite, is singularly free from impurities, particularly the beneficial impurity, iron oxide. Typical analysis is as follows:—

SiO_2	Al_2O_3	Fe_2O_3	CaO.	MgO.	Ignition Loss.
3.7	.88	.70	29.6	21.0	44

The iron oxide helps the dead burning of both magnesite and dolomite at a comparatively lower temperature. The dead burning operation in both cases converts the amorphous variety of the magnesium oxide to the crystalline variety principally periclase. Without iron oxide, this conversion is not possible at temperatures less than 1700°C .

In dolomite commonly used abroad for metallurgical purposes, iron oxide is disseminated evenly throughout the raw mass. It is therefore easy to dead burn them in shaft kilns at the comparatively low temperature of 1450°C . In the case of Indian dolomite which, as has been pointed out is very pure, iron oxide must first be intimately mixed with the raw material before calcining. Shaft kilns cannot be considered for dead burning Indian dolomite. The common practice of charging small lumps of dolomite mixed with iron scale and coke in shaft kiln is useless for the purpose of getting uniform dead burnt product. The points of contact of iron oxide with dolomite may yield perfectly dead burnt material, but then the core of lump dolomite charged would be under burnt (being free from iron-oxide), or else if the temperature is not carefully controlled may produce over burnt slaggy material at the surface of contact with dolomite and iron scale.

The logical step to dead burn the pure variety of Indian dolomite mix it with iron oxide (for example in a pan) and dead burn in a rotary kiln whose flame temperature should be at least 1650°C . Later processing should produce burnt dolomite as good as obtained at any other place.

(5) *Manganese Ore*: India of course possesses excellent large deposits of this material. These are again found very well distributed. Practically inexhaustible deposits are located in Madhya Pradesh, Bombay Presidency, Madras and

Mysore state have also considerable deposits of this ore. The two main producers draw their requirements for the production of ferro-manganese etc. from deposits in Orissa situated among those of iron ore. Typical analysis² of high grade ore is as follows :—

Mn.	SiO ₂	P.	Fe.
50.10	3/8	.02/.15	7.5

(6) *Refractories*: An extensive refractories industry is established on or near the Bihar-Bengal coalfields, where raw materials suitable for the manufacture of fireclay and silica shapes are found. Its present capacity is 250,000 tons per annum. In recent years magnesite refractories have been developed from the extensive deposits in Madras and Mysore. Good quality chrome ore ($\text{Cr}_2\text{O}_3 = 42/44\%$) is available in adequate quantity in Singhbhum district of Bihar. The Indian refractories have been found as good as if not better than manufactured in other countries. When put to conventional tests the Indian refractories come out superior to most of the foreign make.⁹ Faulty operation is more often the real cause of the short life obtained by the Indian refractories in practice.

Present Iron making practice in India: Both Tata Iron & Steel Co. and Indian Iron & Steel Co. use Coke as fuel and limestone as flux in their blast furnaces. TISCO has five furnaces having annual capacity of about 11,00,000 tons of pig. IISCO has two furnaces at the Hirapur Plant having annual capacity of 4,80,000 tons and two furnaces at the Kulti plant having annual capacity of 2,20,000 tons. Both these companies use iron ore and coking coal more or less of similar characteristics and as would be expected there is much similarity in their practices.

TISCO'S main sources of ore are—

	SiO ₂	Fe.	P.	Mn.	Al ₂ O ₃
1. Gorumahisani	4.25	59.59	.066	.50	4.04
2. Bodampahar	4.93	56.33	.093	.54	4.57
3. Sulaipat	2.66	65.67	.065	.15	1.59

IISCO'S sources of ore are—

1. Birds	3.08	60.92	.04	.05	4.92
2. Ropeway	2.53	59.18	Trace	Trace	5.28
3. Manoharpur	2.90	61.66	Trace	.04	3.60

From the above it will be seen that ores used by both the companies have a much higher Alumina/Silica ratio as compared to good quality ores obtainable in other parts of the world. Furthermore, both the companies have to use coke with high alumina bearing ash. The overall effect is that blast furnace slag in India has the highest alumina content in the world. A few typical analysis of slags are given for comparison purpose.

	IISCO (Hirapur)	Tatas	Corby (U.K.)	Tipton Greens (U.K.)	South Wales.
SiO ₂	29	32.11	32.0	40.0	40.0
Al ₂ O ₃	28	22.44	22.0	13.0	11.0
CaO	36	39.67	33.0	41.0	23.0
MgO	3.5	3.17	6.0	3.5	1.0
MnO	1.3	1.25	—	—	—

	Nova Scotia.	Alabama (U.S.A.)	Rhenish (Prussia)
SiO ₂	30.8	37.92	49.57
Al ₂ O ₃	16.22	13.52	9.00
CaO	47.55	38.97	0.0
MgO	3.31	7.10	15.15
MnO	—	—	25.84

From the above it will be seen that Alumina content of slag at IISCO is the highest of all the slags. Tata's figure comes next.

Charcoal Iron : Mysore works has one small blast furnace having annual capacity equal to 28,000 tons. Charcoal is used instead of coke. Iron ore used at the Works has the following analysis :—

SiO ₂	Fe.	Al ₂ O ₃	Mn.	P.
2.54	58.5	5.0	.05	.05

Pig Iron produced analyses to :—

Si.	Mn.	P.	S.
0.5-1.10 %	0.5-1.00	.12	Trace to .02 %

Resulting slag analyses to :—

SiO.	Al ₂ O ₂	CaO.
36.6	27.8	30.0

Again it will be seen that slag produced at Mysore works has a high alumina content.

Present Steel Melting Practice :

The Tata Iron & Steel Co. has the following Melting Shops :—

Melting Shop No. 1 : This shop consists of eight furnaces ranging in size from 70 to 130 tons which use the straight open hearth process for which plant scrap provides 55-60 per cent of the charge. Bulk of the production of this shop comprises quality steels such as forging grades, high tensile, high silicon and low alloy steels. The production potential of this shop in its present condition, may be taken as 300,000 tons of ingots.

Melting Shop No. 2 : This shop is equipped with two 250 ton and one 100 ton open hearth furnaces which are served by three 25 ton Bessemer converters. The capacity of this shop is 650,000 tons of ingots.

Melting Shop No. 3 : This shop is producing acid steel by triplex process. It consists of two 50 ton furnaces served by one 25-ton Bessemer converter.

Electric Furnace Plant : This plant consists of two 5-ton electric arc furnace and a 10-cwt. high frequency furnace.

Melting Shop No. 3 along with Electric Furnace Plant manufacture steel for specialized products. The capacity of both the plants together can be taken at 85,000 tons annually.

The Steel Corporation of Bengal, Ltd.

There is one shop consisting of three 225 ton open hearth tilting furnaces one 90 to fixed furnace, served by two 25 ton Bessemer converters. Basic steel

is manufactured by semi-duplex practice. Under the present conditions, the annual capacity of this plant can be taken at 4,40,000 tons. 10.

The Mysore Iron & Steel Works : There are two basic open hearth furnaces manufacturing steel in the conventional manner and three electric furnaces of $3\frac{1}{2}$ ton, $\frac{1}{2}$ ton and $\frac{1}{2}$ cwt. capacity. The annual capacity of the whole plant can be taken at 30,000 tons of ingots and castings.

Government Ordnance Factories and other Producers :

There are three Government Ordnance factories—one at Ishapore near Calcutta, one at Cawnpore and the other at Muradnagar, near Meerut. Their production is primarily of a specialised nature to meet service requirements.

Of the smaller firms producing steel for castings, a few operate rolling mills. The Bhartia Electric Steel Company and the National Iron & Steel Company in Calcutta, the Mukand Iron & Steel Co. in Bombay and the J. K. Iron & Steel Company in Cawnpore together have an electric and open-hearth steel melting capacity of some 40,000 tons.

Summarizing :	potential Production for iron. Tons.	potential for Production steel ingot. Tons.	potential of Production saleable steel. Tons.
Indian Iron & Steel Corporation of Bengal, Ltd.	7,00,000	4,40,000	3,48,000
Mysore Iron & Steel Works.	28,000	30,000	25,000
Ordnance & other Producers.	—	—	70,000
Tata Iron & Steel Co.	11,00,000	10,50,000	7,80,000
TOTAL	18,28,000	15,20,000	12,23,000

Ferro-Alloy Industry in India :

This industry is not much developed in this country. Tata Iron & Steel Company and Indian Iron & Steel Co. produce in their blast furnaces all the country's requirements of Ferro-Manganese. The Mysore Iron and Steel Works is the only indigenous producer of Ferro-Silicon. They have two 1500 KVA Ferro-Alloy Furnaces with total capacity of 2,000 tons. One 12,000 K.V.A. Ferro-Silicon furnace has been recently installed having an annual capacity of 6,000 tons.

After having described the practice and the capacity of the premier existing plants, we would now review some of the striking departures of the Indian Practice from the normal method of manufacturing iron and steel.

Manufacture of Pig Iron :

The pig iron is manufactured in India in the conventional way in fairly modern blast furnaces. No beneficiation of materials has been seriously attempted. Processes like sintering and coal washing, so common in the modern iron and steel works, have not found their place in this country. It is only recently that we

have started just thinking on these lines. We have not to go very far for finding out the reasons for this. In pre-war days, the labour was very cheap. The Singhbhum iron ore could be mined so cheaply that it could be delivered at the Iron Works at Jamshedpur, Hirapur or Kulti at Rs. 3/4/- per ton. Similarly, coal price at pit heads was of the order of Rs. 1/12/- per ton and transportation and handling expenses never exceeded Rs. 1/8/- per ton. These figures were about 1/3rd of those obtaining anywhere else in the world.

In other words, the extra consumption of the raw materials was never a serious factor in overall cost set up in the manufacture of pig iron. Industry never thought of improving on the lines of its foreign counterpart as there was no fear of any competition from outside. Natural advantages together with indigenous cheap labour weighed so much in favour of the Industry that with all the extra consumption of raw materials, pig iron could be produced at about Rs. 18/- per ton, which was the lowest in the world.

Another striking difference we notice in the Indian Iron making practice. The consumption of 2200/2300 lbs. of coke per ton even after allowing for high ash content of the Indian coke appears to be on a high side. Partly this is due to high alumina content in the slag, which being a poor desulphuriser, the sulphur removal is done by carrying an additional lime in the burden requiring extra coke. Furthermore, there is a lack of uniformity in the chemical composition of the iron ore and coke—there being no up-to-date blending arrangement like Robbins Messiter Bedding system. The blast furnace operators cannot adjust the burden to varying condition and they usually err on the safe side by running the furnace on a hotter side which means more usage of coke. The extra coke provides comparatively a higher concentration of carbon which results in a comparatively higher carbon content in the Indian pig iron. Below is given the typical analysis of Indian and British Basic Pig Iron for comparison :

	C.	Si.	S.	P.	Mn.
British	3.5	1.0	.06	1.45	1.2
Indian	4.3	1.1	.04	.22	1.2

The main difference however in our iron and British iron is in the phosphorus content.

Manufacture of Steel :

Selection of the proper steel making process depends largely on the nature of the available raw material. When large quantities of scrap can be purchased from outside sources, as in most industrial countries, the straight open hearth process is likely to be favoured. The quantity of scrap which can be purchased in India, however, from sources outside the plant is very small, and for all practical purposes, it may be considered that only the scrap generated in the plant itself is available for steel making. In India, however, due to the great shortage of steel it has been found advantageous to sell a certain proportion of the plant scrap to small re-rollers, with the result that not over 10 to 15 per cent of the total tonnage of ingots produced or about one-half of the actual scrap production of the plant is generally available for plant re-cycling. It is evident, therefore, that in India the major raw material for steel making must be pig iron in which case the open hearth process cannot be considered as most suitable. Moreover, as alluded already, there is a tendency to run the blast furnaces on the hotter side to keep sulphur down and this results in a higher silicon content (about 1.2 to 1.4 %) than is usually to be preferred in the basic iron. Again, the indigenous raw materials are such that pig iron can be produced to the required narrow manganese

specification of the Bessemer iron. All these factors, doubtless, have given rise to the idea of duplexing in India. This is the process adopted by both the major steel plants and about 70 % of the total steel produced is made by this process.

Unfortunately, however, the Duplex process is not well suited for the use of scrap. Where some amounts of scrap are available, as in the instance of plant scrap generated in the rolling mills, the former normal practice, when the major portion of the plant's production was to be made by the Duplex process, was to provide additional straight open hearth facilities capable of utilising the excess scrap produced in the Plant. This practice is followed by Tata where two-thirds of the whole production is made from pig iron by the Duplex process and one-third by the straight open hearth process utilising available plant scrap for about 50 per cent of the open hearth charge.

The more modern practice, however, in circumstances where steel is to be made chiefly from pig iron but scrap supplies are available and if pig iron permits, is to employ a semi-duplex process. In this practice the charge consists in approximately 80 % blown metal and 20 % scrap. This type of practice is followed by SCOB as there is no separate open hearth Melting Shop as in the case with Tata's works.

Operation difficulties and their solution :

(1) In the manufacture of pig iron :

Slag analysis gives alumina content of about 27/29 % which is, as already mentioned, the highest in the world. Table I shows a typical burden chart. The desulphurization power of this slag in comparison with those of American and British practice is only about one-half of the latter implying that in comparison with operation in these countries the same desulphurization effect could be obtained in our practice with one half of our present slag volume, if the detrimental influence of high alumina slag could be eliminated. The overall effect of this is reflected in too high a rate of coke consumption as already mentioned.

There are two alternatives before us namely :

- (i) Beneficiation of ore and coke to effect reduction in quantity of alumina getting into the burden.
- (ii) To run on acid slags by cutting off as much limestone as possible. By this method only the partial removal of sulphur is attempted in the hearth. The final removal is done in the ladle by use of sodium carbonate.

In the following paragraphs, these have been discussed seriatim :—

(i) Beneficiation of ore and coke :

Ore : It may be stated that quality of iron ore deteriorates progressively as the size decreases. Typical figures regarding this are given below :—

Size of ore.	SiO ₂	Al ₂ O ₃	Fe.
5 "	1.04	2.52	65.6
— 5 " , + 4 "	1.12	2.60	64.6
— 4 " , + 3 "	2.46	4.45	61.6
— 3 " , + 2 "	2.90	3.95	61.2
— 2 " , + 1 "	3.00	4.70	60.0
— 1 " , + ½ "	3.60	5.04	59.6
— ½ " , + ¼ "	4.90	6.42	58.6
— ¼ "	10.33	11.34	49.8

TABLE I
I. L. & S. Co.
BURDEN FOR BASIC IRON.

Materials.	Net Wt.	Fe.	Mn.	P.	SiO ₂	Al ₂ O ₃	CaO.	Mgo	S.
Iron ore.	-- 34000 lbs.	20103 (59.1%)	17.0 (.05%)	10.2 (.03%)	1105 (3.25%)	1530 (4.5%)	85 (.25%)	Trace	Trace
Limestone	-- 7350 "	22 (.3%)	Trace	Trace	367 (5%)	183 (2.5%)	3528 (48%)	258 (3.5%)	Trace
Coke	-- 19800 "	297 (1.5%)	Trace	49.5 (.25%)	2277 (11.5%)	1366 (6.9%)	198 (1%)	49.5 (.25%)	118.8 (.6%)
Mn. ore	-- 1200 "	276 (23%)	372 (31%)	.6 (.05%)	54 (4.5%)	66 (5.5%)	Trace	Trace	.6 (.05%)
TOTAL	--	20698	389	60.3	3803	3145	3811	307.5	119.4
REDUCED	--	20589	257.97	60.3	707	NIL	NIL	NIL	5.97
Slag.	--	109	131.03	NIL	3096	3145	3811	307.5	113.43

ANALYSIS

Slag.	Iron.
SiO ₂	Fe.
Al ₂ O ₃	C.
CaO	Si.
MgO	Mn.
Fe	P.
Mn	S.
S.	

Total Pig made	22014 lbs.
Per ton of Pig Slag made	1100 lbs.
Slag Volume	10841 lbs.
Slag Pig	49.4 %

CaO/SiO₂ --35.1/28.5 = 1.23

Screening iron ore at the Mines before loading into wagons, fines below $\frac{1}{2}$ " being discarded on site should effect substantial improvement in the grade of iron ore and furnace operation. A saving of 120/130 lbs. of coke per ton of iron could be expected. But the screening of iron ore and discarding fines will increase cost of ore in proportion to quantity discarded, and this should be put against the gain due to reduction in coke consumption mentioned above.

We wonder if washing of iron ore has ever been seriously attempted in India. It is just likely that this ore may be beneficiated immensely by this method.

Coke : It will be seen from the burden chart (Table I) that half of the slag volume is made up of ash from coke and the lime required to neutralise the silica part of the ash. Any reduction in ash content of the coke would effect the decrease in the slag volume with consequent decrease in coke rate. It has been generally found that cleaning of coals to a low ash figure does not involve increased drawing on the reserves, due to a reduction in coke consumption. Though it is true that the Indian coal, having an inherent ash content, is not as amenable to washing as the coal in U. K.; it has been found that in spite of this disadvantage, the advantages accruing from washing the Indian coals more than outweigh the disadvantages. By using clean coke the blast furnace operation is bound to improve resulting in appreciable reduction of coke rate and an improved quality of iron.

(ii) *To run on Acid Slags :*

It has been noticed that any reduction of limestone in the burden is accompanied by a rise in sulphur in the iron, though this means a definite reduction in the coke rate. An additional lime has to be carried in the Indian practice in an effort to keep down the sulphur. Similar troubles were encountered in Corby Works (U.K.) where the conditions are more or less similar to ours. They purposely run on acid slag—the lime/silica ratio being about unity and they get over the sulphur trouble by carrying out the desulphurization in the ladle by use of soda. An increase in throughput of the furnace in addition to reduction of coke rate to the extent of 400 lbs, more than offsets the expense involved in desulphurization process by the use of soda in the ladle.

We are of the opinion, that the experiments should be run on this line with a view to ascertain the feasibility of adopting this practice in this country.

While on the subject of sulphur removal, we would incidentally mention how sulphur could be removed from iron by simply increasing the holding time of iron in the open top hot metal ladles. The sulphur drop between the blast furnace and the open hearth is of interest and following table gives the results of tests carried out in U.S.A.,

No. of tests.	% Mn in iron.	% S. in iron at blast furnace.	% S. in iron at O. H. Mixer.
21	1.39	0.87	0.041
89	1.72	0.70	0.035
26	2.13	0.73	0.031

In India, it is worth while experimenting with removal of sulphur in ladle by using Mn. ore alone or in conjunction with Soda. This will also help in part desiliconization of iron.

A further possibility of combating this problem of high alumina slag lies in the addition of MgO to the slag to improve its fluidity and desulphurization power. Experiments in America have shown that difficulty arising from high alumina slags could be partly rectified by increasing MgO content of the slag. With American practice when alumina in the slag is of the order of about 12 to 15 % it has been noticed that the best desulphurizing slag is one containing about six percent magnesia.¹¹

This particular composition may or may not be ideal in Indian practice with 22/28 % alumina content in the slag ; however, it is worth while carrying out experiments in India with a view to obtain a corresponding optimum MgO content in the slag. MgO content can be increased by partial substitution of limestone by dolomite in the Burden. India has abundant supply of good quality dolomite available in the vicinity of the existing steel plants and there will be no difficulty regarding its availability.

In fact, in the past, Tata Company was using 100 % dolomite as flux in the manufacture of basic iron.¹² Here are a few figures in connection with that practice.

Materials consumed per ton of pig iron.

Coke	--	--	--	--	2102 lbs.
Dolomite	--	--	--	--	1172 lbs.
Ore	--	--	--	--	3398 lbs.

Average Pig Iron Analysis.

Silicon	--	--	--	--	0.88 %
Sulphur	--	--	--	--	0.032 %
Phosphorus	--	--	--	--	0.325 %

Average Slag Analysis.

SiO ₂	--	--	--	--	29.21 %
Al ₂ O ₃	--	--	--	--	20.59 %
CaO	--	--	--	--	29.52 %
MgO	--	--	--	--	17.04 %
FeO	--	--	--	--	1.57 %
MnO	--	--	--	--	1.25 %

The above seems to be a very creditable performance. At present Tata Company does not follow this practice. They have completely replaced dolomite by limestone. We would like to know from any gentleman from Tatas why did they give up the above practice in favour of the present one ? Is it because that since they have switched on to Duplexing requiring Bessemer quality iron, (a higher silicon than basic iron) there is no need of following the dolomite practice which is essentially suited to the manufacture of low silicon and low sulphur irons :

(2) *In the manufacture of steel* : The raw materials available for the manufacture of steel namely pig iron, iron ore, limestone are so pure that it should be easier to manufacture steel in India than anywhere else in the world making steel in Basic Furnaces. While British and most of the Continental steel works use iron with 1.5/2 % phosphorus, the Indian pig iron contains only .25/30 % phosphorus.

It is therefore, comparatively much easier to make steel in India than anywhere else. But for this phosphorus, Indian pig iron is as good as the best Swedish haematite iron. As a matter of fact, in very early days of Tatas (in 1914) at the beginning of the 1st World War, by the time the Germans working on the melting shop were interned, English steel melters, mostly from Middlesbrough district arrived and it was amusing to notice that for their first few days at work they seemed to attack the 0.35 % phosphorus with somewhat of the same vigour that they had attacked their 1.6 % phosphorus at home with the result that they produced a considerable number of heats at first with less than 0.01 % phosphorus in the finished steel.

With no sulphur to be removed and with low phosphorus content of the charge, the best method in India obviously is one of catching the carbon coming down, the amount of lime and oxide of iron used being so proportioned that the phosphorus would be sufficiently low before the proper carbon is reached and the slag would also be in good finishing condition at the same time.

This practice of course demands a very rigid process control but it has been found that it is worthwhile taking this trouble in this direction as improvement in quality of steel made by this process amply justifies it.

Dolomite, which is used as a fettling material in the furnaces, is reputed to be the weak spot in Indian steel making but this is an erroneous view as already referred to. Thus we have everything in favour except probably one. Sufficient thought has not been given to the research part of it. We have here neither quality nor process control of the type or standard we find in other countries. If this is taken up in right earnest, we see there cannot be any difficulty in making any type of alloy steels in India similar to those being manufactured in U.K., U.S.A. or anywhere else in the world. As a matter of fact various kinds of alloy steel were successfully manufactured during the last War at Tatas works, such as high speed steel, hot die steel, bullet proof armour plates, a special alloy steel for shear blades and a special deep drawn quality steel for cartridge cases. The armoured car built in India with Indian steel did magnificent service in the 8th Army's forward drive in North Africa.

The Indian Steel Industry has been dependent on foreign supplies of ferro-alloys but owing to the exigencies of War, a modest beginning has been made to develop their production. India possesses in abundance raw material required for the manufacture of ferro-manganese, ferro-silicon and ferro-chromium¹². Manganese ore contains 40/50 % manganese. Quartzite rocks containing 95/98 % silicon occurs in most parts of India and chromite containing 40/50 % chromium is available in Singhbhum (Bihar) and Mysore. Vanadium bearing titaniferous ore are known to occur in Singhbhum (Bihar and adjacent part of Mayurbhanj state and deposits of tungsten ore exist in Jodhpur state, and in Midnapur district of West Bengal. Titanium ore (Ilmenite) is found in sufficient quantity in South India, while Rock Phosphate which can be utilized for the manufacture of ferro-phosphorus is obtainable from Madras and Singhbhum.

From above it will be seen that practically all the ferro-alloys usually required for the manufacture of special steels could be manufactured in India from the indigenous materials. With the commissioning of the Damodar Valley Scheme resulting into cheap electrical power being available, we visualize a very thriving industry of ferro-alloys growing up in Bihar which apart from meeting the need of the existing steel industry should be available for export.

We would like to see experiments carried out using the Thomas process

for the manufacture of straight carbon steels which forms even now 90 % of the total production of steel in India. Thomas process is definitely much cheaper than the Duplex process. We are led to believe that the original pioneers of steel industry were influenced by the American practice resulting in the adoption of the Duplex process in India. Thomas process would bring down the cost of an ingot by about Rs. 20/22 per ton. Some might argue that phosphorus content (3 %) of the pig iron in India is not sufficient to allow steel being manufactured by the Thomas process. The argument is based upon the general belief that without phosphorus in sufficient quantity (1.5 to 2 %) in the iron it will not be possible to attain sufficient temperature. This is true, no doubt, for relatively low silicon iron. But as is the case in India, the alumina slag in the Blast Furnace favours those factors which tend to make high silicon irons, why not harness this devil of silicon and make it generate heat in a similar way the phosphorus does in the conventional Thomas process! A high carbon content of the Indian pig iron would also help in this direction. It may be that the thermal conditions would then be too high prior to the after blow to allow the Phosphorus removal to take place.

In our opinion steel plant in India could have basic converters backed by basic and/or acid open-hearth furnaces. Bulk of the steel, such as for sheet bar, structural, and other ordinary straight carbon type should be directly manufactured at Basic Bessemer Plant. Basic furnaces should be used to utilise plant scrap in conjunction with blown metal while acid furnaces should only be used for making special steel for railway rolling stock, boiler plates, locomotive forgings etc.

Future of Indian Iron and Steel Industry:

As is the position now, the existing steel plants cannot meet country's demand for steel. The present demand is estimated about 2 million tons per annum, but the existing production is round about 1.2 million tons, leaving about 0.8 to 1 million tons to be imported from outside.

Both the major steel plants and the Bhadrabad Works have extension programmes which would increase the production by about 0.3 to 0.4 million tons. The present consumption of steel per head in India is about 7 lbs. per annum compared with 750 lbs. in the U. S. A. and some 600 lbs. in the U. K.¹⁴

It appears to us from this that our planners do not seem to be very bold in their planning. At present the cost of production of steel in India is probably the lowest in the world. The cold process control and adoption of Thomas process for the manufacture of ordinary straight carbon commercial steel would substantially further reduce the cost.

We would conclude that India with immense natural advantages which have no parallel in the world should plan her steel industry not only for her internal consumption but also for large export trade. From the Indian point of view, shipping iron ore out of the country to be made into steel elsewhere, would be a very shortsighted policy. Anyone who has travelled in India, some 30 years back, has been carried over rails marked "Made by the Carnegie Steel Company, U.S.A." If India is wise enough to further her steel industry, Americans—the world's leading steel producers of today, some day may ride over rails right in their own country stamped "Made in India."

REFERENCES IN THE DATA.

- (1) *History of Hindu Chemistry* by Sir P. C. Ray.
 - (2) *Iron in Antiquity* by J. Newton Friend.
 - (3) *Imperial Gazetteers—Government of India 1909—1919.*
 - (4) *Transactions of the Mining, Geological and Metallurgical Institute of India.*
 - (5) *Private Diary of the Early European Adventurers in India.*
 - (6) *Draft Outline of the First Five Years Plan by National Planning Commission—Government of India.*
 - (7) *Memorandum on the conservation of Metallurgical Coal by Tiao & HSCO.*
 - (8) *Blast Furnace Practice* by Fred Clements.
 - (9) *Transactions of the Indian Ceramic Society.*
 - (10) *Report of the Indian Tariff Board on the Fair Retention Prices of Steel Produced (1951)*
 - (11) *Year Books of the American Iron & Steel Institute.*
 - (12) *Iron & Steel Institute's Journals.*
 - (13) *Iron & Steel* (Louis Cassler's publication).
 - (14) *Transactions of the Royal Society of Arts (London).*
-

DISCUSSIONS.

ANALYSIS OF TIME SERIES

Section of Statistics.

Application of the spectral Theory to Time Series.

K. NAGABHUSHANAM, Waltair.

For analyzing Time Series, it is convenient to adopt the view-point of stochastic processes. The series of observations extending to infinity in both directions is called a "realization." The collection of all possible realizations with a suitable P-measure put upon it may be described as a stochastic process. The same can be regarded also as a collection of random variables. We write the process shortly as $X(t)$, dropping the probability variable. $X(t)$ is a sequence or a function of the continuous variable t , according as t , the time parameter take only integral values, or all real values.

Let the operation of taking expectation be denoted by E . Then a stochastic process is defined to be stationary in the sense of Khintchine if

$$i) \quad E[X(t)] = M, \text{ a constant}$$

$$\text{and } ii) \quad E[X(t) - M][X(s) - M] = R(t-s), \text{ a function of } (t-s).$$

For such process we have under suitable restrictions :

$$R(t) = \int_{-\omega}^{\omega} e^{it\lambda} d\sigma(\lambda),$$

if the process is of continuous parameter t ,

$$\text{and } R(t) = \int_{-\pi}^{\pi} e^{it\lambda} d\sigma(\lambda),$$

if the process is of the type where t takes only integral values. Here $\sigma(\lambda)$ is bounded, real, non-negative, and non-decreasing, and is called the spectrum of the process. The process itself has the representation of Cramer:

$$X(t) = \int_{-\omega}^{\omega} e^{it\lambda} dz(\lambda) \quad \text{or} \quad X(t) = \int_{-\pi}^{\pi} e^{it\lambda} dz(\lambda),$$

as the case may be, provided the integrals are interpreted suitably.

These above tools can be used in practical cases if we regard a trend-eliminated time series as a sample series from a stationary stochastic process.

Estimation of the mean value:

If we regard a (real) time series as stationary, and desire to estimate the mean value of the process, we may take observations constituting n consecutive values. (The discrete case is considered here. For the continuous case see U. Grenander: Stochastic processes and statistical Inference, Arkiv for Matematik 1950).

Then we state the following theorem.

Theorem: $\sum_{r=1}^n \alpha_r \times (t_r)$ is a linear unbiased estimate of

minimum variance of the mean value of the process, if and only if

$$i) \quad \sum \alpha_r = 1, \text{ and } ii) \quad \sum_{s=1}^n R(t_r - t_s) \alpha_s = 0$$

independent of r .

In the particular case when the process is a real stationary normal Markoff one, the constants are given by

$$\alpha_1 = \alpha_n = \frac{1}{n-(n-2)c}, \alpha_2 = \alpha_3 = \dots = \alpha_{n-1} = \frac{1-c}{n-(n-2)c}$$

where c is the constant (numerically less than or equal to unity) in the relation

$$R(p) = \rho^2 c^{1/p}$$

Effects of smoothing:

If we write $L X(t) = X(t) + a_1 X(t-1) + \dots + a_n X(t-n) = U(t)$ we get the relationship between the spectra of the X and U processes as:—

$$\left| 1 + a_1 e^{-i\lambda} + \dots + a_n e^{-in\lambda} \right|^2 d\sigma_X(\lambda) = d\sigma_U(\lambda).$$

This relationship shows the shift in the emphasis of the spectral frequencies of the two processes, and constitutes the Yule—Slutsky effect. Using Lebesgue decomposition of additive set functions we find that a periodicity in $X(t)$ may be effaced and not appear in $U(t)$, whereas every periodicity in $U(t)$ is present in $X(t)$.

Repeated smoothing leads to a process whose spectrum tends to a pure step function, so that the process tends to the sum of purely stochastic periodic terms. The situation is consequently a inusoidal limit as in Slutsky's famous theorem.

Gaussian Markoff Property:

Let $X(t)$ be a real, stationary, Gaussian, Markoff process, and let L stand for the linear operation of forming weighted sum of values of the process at various time instants. Let us as before write

$$L X(t) = U(t).$$

In the continuous parameter case, and in a special case of L for processes of discrete parameter, it was proved by the author (see my thesis : The Primary Process of a Smoothing Relation, Arkiv for Matematik, 1951) that $U(t)$ does not share the Markoff property. The conjecture that in the discrete parameter case also the same result holds for all L is now proved here. This has an important bearing on practical problems dealing with two linearly related processes, viz., that not both of the processes can be taken to possess simultaneously the Markoff property.

In conclusion the effectiveness of the spectral theory as a tool in problems of inversion, estimation, and prediction is explained.

Tests of Significance in Time Series.

K. S. RAO, Bombay.

Tests of significance in Economic Time Series become very necessary prior to the application of the results of normal regression theory. The point of view adopted in the present discussion by the author is to present tests such that, if they are not satisfied by given data, the basic assumptions underlying the choice of the setup for the analysis and interpretation of the data are to be revised

$$I. \quad \text{Let } u_1, \dots, u_n \quad \text{--} \quad (1)$$

have a multivariate normal distribution with the same mean for each component and a certain dispersion matrix. It is possible to find a set

$$\xi_1, \dots, \xi_n \quad \text{--} \quad (2)$$

where $\xi_1, \dots, \xi_n$ are normal variates which are mutually independent, have different means but the same variance, such that the expected value of the periodogram (2) is the same as the expected value of the periodogram (1). If we are using expected values of periodogram in our tests of significance and have no facility for replication, then we are at liberty to choose either of the assumptions underlying (1) and (2). Here we assume that a given set

$$y_1, \dots, y_n \quad \text{--} \quad (3)$$

is such that the numbers are independent normal variates with the same variance but with different means.

The vector in (3) is resolved along n mutually orthogonal directions in n space, one of them being the equiangular line. Let

$$x_1, \dots, x_n \quad \text{--} \quad (4)$$

denote the components along directions other than the equiangular line. We wish to test the null hypothesis H_0 that the means of the variates in (3), are the same against the set of alternative H_1 that the means are different.

If H_0 is true, the set of numbers in (4) are independently normal $(0, \sigma^2)$. Then if

$$t_1 = \frac{x_2}{|x_1|}, \quad t_2 = \frac{x_3}{\sqrt{\frac{1}{2}(x_1^2 + x_2^2)}}, \quad \dots, \quad t_{n-2} = \frac{x_{n-1}}{\sqrt{\frac{1}{n-2}(x_1^2 + \dots + x_{n-2}^2)}} \quad (5)$$

$t_1, \dots, t_{n-1}$ are independently distributed as Student's t 's with $1, 2, \dots, n-2$ as their

respective degrees of freedom. By considering the upper and lower $P/2\%$ tailends of the t-distributions as values the critical region for getting a rejection, and the region outside as the region for acceptance, each of the independent t's in (5) give rise to a set of $(n-2)$ acceptances and rejections. If the number of rejections obtained is significantly different from the expected number at the 5% level of significance we reject the null hypothesis H_0 .

II. The same technique is available when

$$y_1, \dots, y_n \quad \text{--} \quad (6)$$

are n p -dimensional vectors.

III. If

$$X_t = \alpha_1 x_{t1} + \dots + \alpha_k x_{tk} + \varepsilon_t; \quad t = 1, \dots, n \quad \text{--} \quad (7)$$

where $\alpha_1, \dots, \alpha_k$ are constants

$$\begin{pmatrix} x_{1s} \\ \vdots \\ x_{ns} \end{pmatrix} \quad s = 1, \dots, k$$

are 'sum' vectors and $\varepsilon_1, \dots, \varepsilon_n$ are independently normal with the same variance. From a set of observations it becomes necessary to test the null hypothesis H_0 that the means of ε_t 's are all zero against the alternatives that some of them are not zero. The least squares method is applied and the residuals calculated. The vector of these residuals is resolved along $n-k$ orthogonal directions orthogonal to the estimation space. If

$$x_1, \dots, x_{n-k} \quad \text{--} \quad (8)$$

are these components, t's can be constructed and used as before.

IV. The method given in III is generalised to the case of simultaneous regression, where a number of independent Hotelling's T^2 are generated and used in the test procedure.

V. The tests given above, besides enabling one to verify whether the conditions required by normal regression theory are satisfied or not, narrow down the hitherto accepted domain of specification in problems of tests of significance in statistics. For example, if we want to see if a set of observations x_{ij} ($i = 1, \dots, K; j = 1, \dots, l$) are in conformity with

$$E(x_{ij}) = \alpha + \beta_i + \gamma_j \quad \text{--} \quad (9)$$

$$\text{We put} \quad E(x_{ij}) = \alpha + \beta_i + \gamma_j + k_{ij} \quad \text{--} \quad (10)$$

The procedure given above is used to test the null hypothesis $H_0: k_{ij} = 0$ for all i, j against the set of alternatives $H_1: (-\omega < k_{ij} < \omega)$. The statistics used in the test being orthogonal to the estimation space, the estimation of the various effects can be done as usual. The method of this paper thus improves the accuracy of the technique of analysis of variance.

Non-Parametric Methods in the Analysis of Time Series.

P. V. KRISHNA IYER, New Delhi.

A number of non-parametric methods has been recommended for examining time series by various writers from time to time. Kermack and McKendrick, and Kendall have used the distribution of the number of peaks and troughs

or the total number of runs or the distance between the upcrosses to decide whether a sequence of observations which all differ from one another can be considered to be random or not. These tests are not sensitive enough to bring out the salient features of the series. They can be improved to a great extent by considering the distribution of the length of the longest run, as has been done by Mosteller. By considering the joint distribution of runs of varying lengths it is possible to make further improvements in these tests. This would require the product-moments for runs of varying lengths and this has been obtained by the speaker and has been published in Vol. III of the *Journal of the Indian Society of Agricultural Statistics*. It is now suggested that a test based on the distribution of the number of observations in a series for a given number of runs is likely to prove much better than any of the aforementioned ones. This distribution for $n = \omega$ has been obtained by Kermack and McKendrick for various values of the number of runs. Using these results it is possible to decide whether a given sequence can be considered to be random or not. If it is not random it is necessary to look for the periodic or the autoregressive nature that might exist in the series. This can be done by applying the periodogram analysis and the serial correlation methods. But they involve very heavy calculations. An idea of the periodicity of the data can be obtained without resorting to the usual periodogram and serial correlation methods by the following procedure :

1. Arrange the data as in the case for a periodogram in the form of a Buys-Ballot table for different values of the periods after classifying the data falling in the different periods into K classes, say, 1, 2, 3, . . . K. Consider now the average length of the runs of the different classes taken along the columns. If this observed average is significantly greater than that for random distribution it can be concluded that one of the periods of the series is that given by the table.

2. Note down the number of observations between (1) successive peaks, (2) 1st and 3rd, 3rd and 5th, peaks, and so on, (3) 1st and 4th and 7th peaks and so on, (4) 1st and 5th, 5th and 9th etc., and find that mean square between the numbers of observations for the various classes and that class for which this variance is the same as that for the expected value, or less, can be taken to be a period of the data provided the average of the number of observations is significantly greater than the expected value. .

Discriminatory Analysis in Time-Series.

C. RADHAKRISHNA RAO, Calcutta.

A discrimination procedure for the classification of time series has been outlined to avoid the pitfalls in the current methods. A special feature of this method is the sequential procedure by which lag correlations are considered one by one till a decision is reached.

1. Statistical Methods in Population Studies.

K. K. MATHEN, Calcutta.

I have been asked to speak on this subject from the public health point of view, and I am glad that this approach conforms to the human approach for scientific problems recommended by our prime minister, in his yesterday's address. One of the primary objects of the study of population is to find out the direction in

which the population is growing in order to make useful predictions about its future size. One of the earliest writers to make comments on this aspect of the population problem was Malthus who made predictions assuming that the percentage rate of increase of human population remains constant, thereby getting the law of geometric progression for the population growth. Other workers like Vernulst, Raymond Pearl and Reed, assumed that the percentage rate of increase of the human population at a given time was linear function of the size of the population at that time and obtained the logistic law for describing this curve. In many of the western countries which recorded a falling death-rate followed by a falling birth-rate during recent times the above condition of linear relationship was fulfilled for certain period of time and therefore the population growth of these countries gave a good fit to the logistic law during these time periods. However, when new technological developments took place, new phases were introduced into these curves and the original logistic curves had to be replaced by new logistics.

A second aspect of population studies was the determination of the points of optimum size of the population for an area. In this connexion I wish to examine the merits of the common indices available with a vital statistician, as bases for it. The crude death-rate suffers from the disadvantage that it depends on the age composition. Infant mortality rate has the advantage that it is a very sensitive index of the health condition of the community during the immediate past. Expectation of life at birth and standardized death-rate, though better than crude death-rate suffer from the handicap that they do not give a whole picture of the health conditions in the immediate past alone particularly in case of deaths due to chronic diseases. All death-rates suffer from the disadvantage that they are not an accurate index of the health of the people, particularly due to the existence of diseases which have very little case fatality rates such as hookworm. In order to overcome the above difficulties one should make use of a morbidity rate which, though difficult to obtain, can be ascertained by means of sample surveys. In fact, sample surveys at suitable intervals should collect information to study the inter-relationship between population growth, standard of living and health. The principle which should be followed in forming policies is that any increase of population should be viewed from the point of view of the health status of the community.

2. Statistical Methods in Population Studies.

A. C. NAG, Calcutta.

The growth of population depends not so much on the total number of children born, as on the number of females (i.e. potential mothers) born. An investigation was therefore made by me on over 50,000 births to determine the probable repercussion of a falling birth rate on sex-ratio (i.e. female/male) at birth. It has been found that:—

1. Sex-ratio is higher in summer conceptions than in winter conceptions which are more numerous.
2. Sex-ratio in all orders of birth, excepting the second, at first decreases with the age of the mother and then tends to increase i.e. it moves in opposite direction to fertility rate.
3. In Calcutta the muslims who exhibit the highest birth-rate have the lowest sex-ratio and the Christians who exhibit lowest birth-rate have the highest

sex-ratio, the Hindus occupying the intermediate position both in regard to birth-rate and sex-ratio.

4. Sex-ratio appears to be higher in the more intellectual sections where the birth-rate has been found to be lower.

All these findings point to the fact that a fall in birth-rate may lead to a rise in sex-ratio. This has in fact happened in Western countries, particularly in France. Nature appears to offer resistance to any planning for reducing the birth-rate by increasing the proportion of potential mothers.

Other interesting features revealed by this investigation are that the first birth appears to encourage opposite sex in the second and that late marriages ordinarily increase the probability of having a son as first issue.

Again sex-ratio has been found to be higher in Bengal and Madras than in Bombay and the Punjab. It may casually be mentioned here that Bombay and the Punjab are inhabited by more martial races and the principal food in those provinces is wheat in contrast to Bengal and Madras.

3. Statistical Methods in Population Studies.

J. SHARMA GULERI, Rajasthan.

In the course of his remarks, drew attention to the comparative futility of deploring the paucity of accurate and complete statistical data in the country but to concentrate in making the best use of whatever is available instead of aiming too high and accomplishing too little. For this it was necessary to arrive at a standardisation of concepts and uniformity of processing based upon a clear appreciation of the limitations of the data. For the much needed impetus to the development of demographical studies what was required was a closer association of the Economist and the Statistician, than is the case at present, that is, the economist to be a Statistician and the Statistician to be an economist and for the establishment of a regular statistical survey service to supplant or supplement the existing village agency which is obviously inadequate to meet the requirements of the new order in the Country.

Co-ordination of Official Statistics.

A. R. SINHA, Calcutta.

Sri A. R. Sinha opened the discussion on the subject by referring briefly to the history of the existing organisation of official statistics in this country (India) which, he said, formed interesting reading. He remarked that the official system in this country began with departmental control, the compilation and publication of the various kinds of statistics being left in charge of the different administrative Departments of the Government of India—according to subjects under their respective control. But the experience of working of the system soon revealed that the statistics compiled and published by the various Departments were not only lacking in uniformity but were found to be overlapping, being moreover conflicting in certain cases. It was also felt that the disconnected manner of compilation and publication of official statistics detracted greatly from their value.

rendering their intelligent examination, collation and interpretation from the wider economic viewpoint extremely difficult and almost impossible. A change in the system was therefore introduced in 1895 by the creation of a "Central Statistical bureau" which was entrusted with the duty of reviewing the various kinds of official statistics and publishing them in a properly digested form. The decentralised system was thus replaced by a centralised scheme, and the subsequent progress and development lay in securing greater and greater uniformity and co-ordination amongst the various kinds of official statistics by the concentration of all statistical work in one place i.e. in the Department of Commercial Intelligence and Statistics which functioned as the central statistical office of the country for a period of about 50 years. But as soon as the last world war broke out there were urgent and widespread demands for statistical information in connexion with the working of war-time policies of control, rationing etc., and the administrative departments were thus forced to make separate arrangements of their own to meet their statistical needs and requirements. This process received further impetus after the cessation of hostilities especially in connexion with the preparation of National plans and reconstruction schemes, and the statistical activities of the administrative Departments showed a marked expansion by this time. They therefore wanted to strengthen their statistical resources further by taking over the statistical work relating to their respective subjects which had so long been dealt with in the Department of Commercial Intelligence and Statistics. The process of disintegration thus set in and was completed when the Departmental claims referred to above were ratified by the Inter-Departmental Committee on Official Statistics appointed by Government soon after the close of the War. There was thus a reversion to the old Departmental system of treatment of official statistics from about 1945, which continues at present. But following the recommendation of the said Inter-Departmental Committee, a separate Central Statistical Organisation has been set up very recently under the Cabinet Secretariat to advise the administrative Departments (Ministries) in connexion with their statistical work and to bring about the necessary uniformity and co-ordination amongst the various classes of statistics compiled and issued by the different Government agencies.

Owing to their historical association in this country, as pointed out above, the problem of co-ordination of official statistics is often confused with that of centralised treatment and unified control. But there appears to be no necessary connection between the two. It is possible to hold divergent views on the method of treatment of statistics. But whatever may be mode of treatment, there cannot be any two opinions on the question of their co-ordination. If the official statistics are to serve the true purpose for which they are wanted, it is obvious that the various kinds of national statistics, viz. those on production, trade, prices etc. should be compiled according to a uniform standard under a common set of definitions, classifications, etc., especially when they are dealt with by different Government agencies, as is at present the case in this country. To ensure smooth and harmonious working of the various official organisations in the country and with a view to securing uniformity amongst the different classes of statistics, there are broadly speaking two major problems of relationship to be solved, viz. (1) co-ordination of activities amongst the statistical units of the Federal Government, and (2) that between the statistical services of the Federal and State Governments. It is thus necessary to secure two types of co-ordination which, for the sake of convenience, may be designated as horizontal and vertical co-ordination respectively. Of the two, the latter (i.e. the vertical co-ordination) appears to be comparatively more difficult to secure and maintain in practice. At least that has been the experience in this country in the past, as the lack of this type of co-ordination stood in the way of bringing about the much needed reforms in the all-India

Statistics, especially after the grant of provincial autonomy. It cannot be gainsaid that there is a great disparity in the conditions and level of progress amongst the different provinces or federating states whose requirements and resources also vary to a great extent. In the circumstances, it is extremely difficult to evolve and prescribe a common statistical programme which would be suitable for all and could therefore be worked up by all the federating states. The position seems to be complicated further by the constitutional position, according to which, the responsibility for collection of data relating to certain important subjects (e.g. agriculture) vests primarily in the State Governments. Accordingly if the primary data collected by the State Governments are not compiled according to a uniform method or standard, the all-India statistics built up from such heterogeneous materials would lose all significance and validity. The question is thus of particular importance and demands early solution. Any refusal to face it properly and squarely or any delay in tackling it is fraught with grave dangers, as such a position may easily envelope the country with statistical confusion and chaos in the near future. The accession to the State Governments, after partition of the Country, of a large number of small and scattered Indian States, covering a fairly large area in aggregate, which could not even boast of a simple and rudimentary type of administration in them, is likely to be another instance where statistical co-ordination may prove to be a difficult job. Further, regarding the methods of collecting even the same information there is some confusion and lack of uniformity : to take an example from the modern method of "sample surveys" (which, of course, is an welcome feature) it seems that even after so many years of experimentation in crop-yield and acreage estimations it has not been possible to arrive at definite conclusions regarding the most suitable procedure for this purpose.

We have so far dealt with only one (i.e. national) side of co-ordination. But it has also an international aspect, on which some remarks are also called for. Under modern conditions, it is not enough to have adequate and satisfactory statistics on a national scale only. It is also necessary that they should be moulded in a form which would permit of comparisons being made with the corresponding statistics of other countries so as to meet international requirements of statistics. No doubt this type of co-ordination is primarily a task for International bodies like the U. N. O. to arrange. But their efforts cannot bear fruit unless the national statistical authorities collaborate in the matter. Ordinarily, it will be advantageous to have this sort of collaboration, as it place varied and accumulated experiences of foreign countries in statistical matter unreservedly at the disposal of the particular country, besides help and advice from the international bodies. But one should be guilty of misrepresentation of the position if he does not refer at the same time to the other side of the picture, i.e. the difficulties that sometimes stand in the way of such collaboration. Briefly the difficulties met with in this field are more or less similar in nature to those described above in the case of vertical co-ordination, though their extent is very much greater in the international field. It is well-known that the capacities and resources of the industrially advanced and under-developed countries, the two broad categories into which the countries of the world may be divided, differ greatly. It becomes therefore difficult sometimes for the latter group of countries to fall in line with the former group of countries in their onward march towards statistical progress. Moreover the standard concepts, definitions and classifications etc. developed for international use and prescribed for general adoption by the international bodies appear to be based generally on the conditions prevalent in the industrially advanced countries of the West which are dominated by money economy. But owing to the existence of barter economy generally in the under-developed countries

such concepts, definitions etc. may be strictly limited in application so far as this group of countries is concerned (cf. usual national income concepts). Under such circumstances, a false sense of prestige may do more harm than good to the country. By all means let us try to secure international comparability but not at the cost of rational requirements.

From what has been said above, it will be sufficiently clear that the problem of co-ordination of official statistics is neither easy nor simple. There are many causes which have been responsible for the present unsatisfactory state of official statistics in this country. But one of the important factors in the situation has so far been the absence of a properly qualified organisation which would make a continuous and systematic study of these questions. With the setting up of a Central Statistical Organisation in the country recently, which has also been relieved of routine compilation, it may be hoped that this problem along with connected questions will receive their due share of attention with a view to early improvement of the position.

Co-ordination of Official Statistics in Bombay State.

M. A. TELANG, Bombay.

Messrs. Bowley and Robertson in their illuminating "Scheme for Economic Census of India" mention that the "statistics of India have largely originated as a by-product of Administrative activity, such as the collection of land revenue or from the need of information relating to emergency such as famines." This criticism made in 1934 is applicable to a certain extent to the statistics collected even to-day. Excluding statistics pertaining purely to Central subjects, viz. Foreign currency, exchange, etc. most of the statistics in India are collected by the agencies operating in the States. Basic statistical data handled in the Government Departments in the State and even at the Centre are supplied by the agencies appointed either by the Departments of the State or by the land revenue administration.

The land revenue administration supplies almost all the statistical information available in the State. The revenue agency consists of a Talathi, Kulkarni or a Patil in the village, a Circle Inspector for supervision of about 20 Talathis, a Mamlatdar for a Taluka of about 120 villages and a collector in charge of about 12 mamlatdars. All the statistics are included in the "Village Forms" which a Talathi or a Patil has to maintain. Finally, the Collector consolidates the information for the district as a whole and in all submits the following returns to Government regarding his district. These returns form the basic statistical structure of the State.

The talathi is in charge of about three villages on an average covering a population of approximately 1000 persons. The Talathi is in fact the basic pillar on which is built the statistical structure of the State. He is charged mainly with collection of revenue in the village, but in recent times, in view of the fact that he is in most cases the only Government servant in the village, he is saddled with additional responsibilities regarding procurement and distribution of foodgrains, etc., and is, thus, rather overworked. In effect, the talathi serves as a link between the village and the Government and as such, he is called upon to assist in almost all the ad-hoc surveys or censuses the Government carries out from time to time. This system of asking one man to do multifarious duties

has of course also its advantages. The talathi is usually a resident of the Village and this helps him considerably in carrying out his various activities.

The statistical material collected either through this agency or through a specially appointed agency by a department is consolidated in the various departments of the Bombay Government. Some of the Departments have special statistical sections while in some others, the work is entrusted to the usual office staff. The statistical set up in the various departments of this Government is given below.

Department of Agriculture. There is a full fledged statistical section in the Agricultural Department. In addition, there are other Statistical Officers working in the Department of Agriculture. There is a Statistical officer under the Deputy Director of Agriculture whose duties are to plan and organize experiments on and trials of plant and breeding and genetic material according to modern statistical designs and to interpret their results. There is also a statistical officer under the Soil Physicist to Government. The work of the Statistical Section can be classified under three main heads, viz. (1) Crop-cutting experiments, (2) Design and Statistical analysis of field experiments and (3) Preparation of crop forecasts and Season and Crop Reports. Crop-cutting experimental surveys on the basis of random sampling technique evolved by the Indian Council of Agricultural Research have been undertaken on the State-wide scale on paddy, bajri, kharif jowar, wheat, rabi-jowar, cotton and tobacco, and five more crops in one district each. In addition to these, separate crop-cutting experimental surveys on irrigated paddy, bajri, wheat and rabi-jowar have already been undertaken in the major canal areas of this State.

Forest Department. The Chief Conservator of Forests is required to submit an annual report on progress made in each division. Part II of these reports includes appendices giving quantitative information regarding various aspects of Forest Administration. This is the only important source of data relating to this department. These statistics are collected in forms prescribed for the purpose in Bombay Forest Manual Volume I. The Statistical Branch attached to this Department has been created quite recently.

Director of Excise and Prohibition. Statistics relating to State Excise are collected in the offices of collector of Bombay and the Director of Excise and Prohibition. Most of the data are supplied by Divisional Superintendents of Excise and Superintendent of Nasik Distillery. Appendices A to J and Annual Returns I to IV published in the Annual Administration Report of the Excise Department show the various items under which the statistical data are compiled.

Registrar of Co-operative Societies. The annual report on the working of Co-operative Societies contains statistical information about the operations of various types of Co-operative Societies in this State. This statistical information is consolidated in the forms A to L and which are printed as appendices to the Annual Report. The statistical returns are compiled by the district audit staff and consolidated on a divisional basis in the offices of the various Divisional Registrars. The Divisional returns are sent to the office of the Registrar, Co-operative Societies, where they are further consolidated on a State-wide basis. There is no separate statistical section in the office of the Registrar of Co-operative Societies.

Settlement Commissioner and Director of Land Records. The only statistical work that is being done in this department consists of compilation of (1) Agricultural Return No. I which gives the agricultural statistics of crop and irrigation for the whole district including the Talukas comprised therein, (2) Agricultural

Return No. II which is an abstract of cattle and resources for the whole district by Talukas and (3) Agricultural Return No. III which gives sources of water supply for the district by talukas.

Inspector General of Registration. The statistical data collected by this Department are compiled in the six statistical statements published in the Annual Administration Report of the Registration Department. There is no statistical staff employed in this Department. The information is annually compiled by the District Registry office in every district from similar information received from each sub-Registry office in the District and from the statement supplied by the Manager, Government Photo Registry, Poona. The information received from these sources is consolidated in this Department and published in the Annual Administration Report.

The Public Health Department. This department has to deal with vital statistics—births and deaths, deaths by different causes, age periods, classes, etc.—of the State. No separate staff is employed for statistical work. Statistical work includes preparation of monthly statements of births and deaths and consolidation of daily returns for epidemic diseases (viz., Cholera, Smallpox and Plague) received from the Taluka Officers and Municipalities.

Surgeon General with the Government of Bombay. This office is concerned with the compilation of (1) The Annual Report on Civil Hospitals and Dispensaries in this State and (2) The Annual Report on Mental Hospitals in this State. There is no special Statistical section in this office. The Civil Surgeons of the districts concerned collect the annual statistical returns and reports in the prescribed forms from the Medical Officers under their control and furnish them to the office of the Surgeon General for checking and compiling the same. Similar information is also collected from Private Medical Institutions in the State. Government have sanctioned the creation of a post of statistician at the Haffkine Institute.

Civil Supplies Department. The Statistical section of the Civil Supplies Department deals mainly with Foodgrains Statistics. The Section is divided into 5 sub-sections. The Statistics dealt with are: rationing statistics, State and district requirements for foodgrains, import quotas from the Central Government, procurement and levy of grains, and prices, etc. The Personal Assistant to Statistician is entrusted with the special enquiries and problems involving research that arise from time to time.

Commercial Intelligence and Industrial Statistics. The principal work of the Section is to carry out the duties and functions of the Commercial and Industrial Intelligence including the preparation of reports on economic condition as and when required by Government and also to implement the Industrial Statistics Act 1942 read with the Census of Manufacturing Industries Rules 1945 framed by the Government of India.

Director of Public Instruction. The Statistical information collected pertains almost exclusively to Annual and Quinquennial Reports of Public Instruction and General Education tables sent annually to the Government of India. Statistical returns relating to Arts and Professional Colleges are collected by the Director of Public Instruction. Returns of Secondary and Primary Schools are collected by the Divisional Inspectors from Heads of Schools through the Administrative Officers of the various Districts and Municipal School Boards. Returns in three groups are called for so as to reach the Director of Public Instruction by 15th July. The data received from these sources are incorporated in the Annual Report of the Director of Public Instruction by 15th July.

Director of Fisheries : Statistics of fish brought to this fish curing yards for curing with salt, are maintained by the respective Yard Officers. The statistics furnish information pertaining to the quantity of fresh fish received at the yard, quantity of salt issued and the quantity of cured fish let out of the yard. Statistics of fresh fish landed at Sassoon Dock, Bombay, are maintained in this office. The statistics of fish at the fish curing yard are sent by the Yard Officers to the Superintendent of Fisheries, Karwar, who collects the information and sends arrival returns to this office for incorporation in the Annual report of this Department. The Statistics of fish landed at Sassoon Dock, Bombay, are furnished by the launch owners to this office direct.

Office of the Dy. Commissioner of Labour. The statistical work done in this Section can be broadly classified into two sections, viz. (a) Cost of Living and Prices (b) Other statistics e.g., industrial disputes, workmen's compensation statistics, absenteeism, employment, etc.

Bureau of Economics and Statistics. The functions of the Bureau of Economics and Statistics are :—

(1) *Co-ordination and Guidance :—*Subject to guidance from the Bureau, individual departments will continue to collect their own statistics. The Bureau will co-ordinate these statistics, suggest improvements in the existing methods of collection, and offer advice in regard to the collection of new statistics. It will provide the requisite liaison between the Central Government and the Bombay Government in respect of all statistical matters. It will organize in the state sphere any statistical surveys required as part of approved All-India Plans.

(2) *Enquiry and Intelligence :—*The Bureau will itself carry out, where that course is more convenient, enquiries affecting more than one Government Department or enquiries of a specialised nature. It will be associated with all socio-economic enquiries ordered by Government. It will prepare and publish an Annual Statistical Abstract for the Province and Monthly Statistical Bulletin, and also undertake, if practicable, the preparation of an Annual White Paper on State Income and Expenditure.

(3) *Research :—*The Bureau will conduct Economic Research and maintain a Statistical Laboratory and a Library.

The main task of the Bureau is thus the assembly of data required by the Government in the execution of its economic and social policy. Almost all the functions assigned to it are being carried out by the Bureau at present.

Co-ordination of Official Statistics.

Mr. NISTARAN C. CHAKRAVARTI, Calcutta.

Referred to the recent conferences of Inter-departmental Statisticians and State Statisticians at New Delhi. Referred to the difficulties in respect of co-ordination in view of the fact there are a number of Ministries at the Centre who want statistics and have to deal with a large number of states each of which has a number of departments who collect or compile statistics. Each central statistical office of each state will therefore have to be organised on lines which suit the local circumstances best. Gave a summary of the development of the State Statistical Bureau of West Bengal which is a centralised organisation to a very large extent.

Section of Medical.

A Discussion on the subgeneric Position of *Phlebotomus* (Diptera : Psychodidae).

Capt. R. D. MITRA, Poona.

The author has reviewed the basis of specific determination of insects with aspecial reference to gnus *Phlebotoms*.

The subgeneric grouping based on the character of the dorsal abdominal hairs on segments II to VI has resulted in the creation of 3 and 2 groups in the identification of female and male *Phlebotoms* respectively. A single species of *Phlebotomus* e.g., *P. squamipleuris* which possess both erect and recumbent hairs on the dorsum of the abdominal segments forms a group by itself by virtue of its having erect hairs on some of these segments. But Mitra and Roy have described a varietal form of this species in which erect hairs are present on the dorsum of all abdominal segments. Besides, this character of the hairs is not an easy guide to classification as (a) the final reliability depends on the examination of the nature of the cicatrices under high magnification in specimens which have been stained and mounted (b) the case with which these hairs are disarranged in capture and subsequent manipulation of fresh and dry specimens (c) this character is not preserved so well in specimens tored in alcohol.

In view of the above it appears that the existing subgeneric classification of *Phlebotomus* based on the arrangements of hairs is not very satisfactory. Other structures on which this classification could be more easily and reliably based are the nature of the pharynx, spermatheca and the spermathecal ducts.

In genus *Phlebotomus* although the phryngeal armature of the female is well developed yet its structure does not provide a basis of subgeneric grouping as found in genus *Anopheles* which has been divided in 5 sub genera on the basis of the structural differences of the buccal and pharyngeal armatures where variation exists amongst the different subgenus but no individual variation are found within a subgenus. The distinction between the presence or absence of buccal characters is not rigid and sharp in *Phlebotomus*.

The *Phlebotomus* may be divided into 2 groups on the basis of the absence or the presence of crenulations in the spermatheca, but because in the group where crenulations are supposed to be absent, occasionally a few striations are seen near the free end, this criterion is subject to variation.

Amongst the *Phlebotomus* which possess short spermathecal ducts, the ducts soon combine to form a common duct but in some species these ducts maintain a separate existence from the spermatheca to the vagina. This character is easily ascertained and is unlikely to be affected in the handling and preservation of the insects or discarded as a basis of subgeneric classification by subsequent finding of species possessing erect and recumbent hairs on the dorsum of all the abdominal segments.

It is, therefore, proposed to classify the genus *Phlebotomus* into 2 subgenera basing this classification on the structure of spermatheca and the nature of its ducts.

If this classification is adopted, it is proposed that only 2 subgenera be recognised in the classification of *Phlebotomus* known to science :—

(a) Subgenus *Phlebotomus*.

(b) Subgenus *Sintonius*.

Subgenus *Phlebotomus* should constitute of those species which do not possess a common spermathecal duct, e.g., *P. papatasi*, *P. hinensis*, ect., and subgenus *Sintonius* of those only where these ducts unite to form a common duct.

Occurrence of Curiously Modified Spines on the Palp of *Psychoda* (Diptera : Psychodidae).

Capt. R. D. MITRA, Poona.

In the middle of the 2nd palpal segment of *Psychoda* a group of curiously modified spines are present. These are situated laterally and are 19 long, 1.8 and 2.6 broad at the proximal and distal ends. These spines are confined within a length of about 32 i.e., a third of the total length of the segment. Unlike the Newstead's spines of *Phlebotomus* these spines are shaped like the Burmese sickle and do not possess a spathuliform end or a long curved pedicle.

Parasites of *Phlebotomus* (Diptera : Psychodidae).

Capt. R. D. MITRA, Poona.

A mite belonging to the genus *Raphignathus* (Sp. Nov. ?) has been found infesting sand-flies in nature.

It is found more frequently on *P. argentipes* than on *P. papatasi* or other species of *Phlebotomus* which are numerically less prevalent in Poona. The infestation is high during the monsoon and post-monsoon months.

Out of the locally collected *Phlebotomus*, 887 and 461 specimens of *P. argentipes* and *P. papatasi* females dissected so far; Nematodes were found in only one specimen of *P. papatasi*.

Section of Zoology.

Occurrence of Curiously Modified Spines on the Palp of *Psychoda* (Diptera : Psychodidae).

Capt. R. D. MITRA, Poona.

Among *Psychoda* (*Psychodidae*) on the 2nd segment of the palp curved immobile setae without narrow pedicle or spathuliform end are present. They arise from the general surface of the cuticle, all point to one direction (Fig. 5) and are 16 to 19 long, measure 1 to 1.8 proximally being slightly wider at the distal end. The number position and distribution of these setae are constant in the species

prevalent in rural Bengal and urban areas of the States of Madras, Bombay and Delhi.

Seven setae are present in the middle third of the 2nd segment in both the sexes, among the females these are distributed in two groups three standing a little distally to the rest, the distribution is even and without any gap in the males. These setae are present along one side of the segment in a cluster 31 long and the length of this cluster is 0.32 times the length of the 2nd palpal segment,

A discussion on the subgeneric Position of *Phlebotomus* (Dipteria; Psychodidae).

Capt R. D. MITRA, Poona.

M The author has reviewed the basis of subgeneric classification of genus *Phlebotomus*.

Some species of *Phlebotomus* possess separate spermathecal ducts which maintain separate existence from spermatheca to the vagina, in others these ducts soon combine to form a common duct.

It is therefore proposed that on the basis of the nature of the spermathecal ducts genus *Phlebotomus* be divided into only two subgenera, *Phlebotomus* be divided into only two subgenera, *Phlebotomus* and *Sintonius*. Subgenus *Phlebotomus* should constitute of those species which do not possess common spermathecal duct e.g. *P. papatasi*, *P. chinensis*, etc., and subgenus *Sintonius* should constitute of those only in which these ducts unite to form a common duct.

Parasites of *Phlebotomus* (Diptera : Psychodidae).

Capt. R. D. MITRA, Poona,

In course of studies on "sand flies" in Poona Cantonment and outlying areas a new species of acari *Raphignatus smithi* has been found infesting sand flies in nature during the monsoon. It is found rather frequently on *Phlebotomus papatasi* and *Phlebotomus argentipes*.

Out of 461 specimens of *P. papatasi* (o) and 887 specimens of *P. argentipes* (o) nematodes were found in a single specimen of *P. argentipes* (o) nematodes were found in a single specimen of *P. papatasi*.

Section of Symposia.

Symposia on Soil Research under the Auspices of the National Institute of Sciences of India—January, 1952.

Micronutrient Deficiencies in Crops in Relation to Some Indian Soils.

N. P. DATTA, New Delhi.

Besides the usual ten elements, the essentiality of a group of another five in the nutrition and metabolic activity of plants and animals is now recognized.

These five are boron, manganese, zinc, copper, and molybdenum. As only a micro amount of these nutrient elements is all that is needed for the completion of the normal life cycle of plants, they are known as micronutrient elements or simply micronutrients.

Some people in the earliest stages used the term, minor elements to designate this group of elements from the so-called major elements, but it was felt by many as quite unsatisfactory as these elements are also of major importance just as truly as N or P in the nutrition of plants though they are required in comparatively smaller amounts. At the symposium of trace elements held at Rothamstead in November, 1947 under the auspices of the International Union of Biological Sciences, the name, micronutrient was finally adopted. Our knowledge regarding them has developed during the last 45 years. The first conclusive proof claiming the inclusion of manganese in the list of essential elements is that of Bertrand in 1905. Since then a great many observations have been made and much experimental work in both the field and the laboratory carried out, while thousands of publications, some of considerable scientific and economic importance have appeared around the world. This is enough evidence to show the lively and active interest that is being displayed in this comparatively new line of research.

Researches on trace elements apart from being a fundamental scientific pursuit have been found to be of considerable economic importance. These elements are absorbed from the soil and malnutrition in plants is nearly always traced to improper nutritional balance either due to a shortage of some nutrient through unavailability or an excess of it leading to toxicity. In the acute form the deficiency shows up in definite hunger signs or symptoms, whereas in latent forms it is not so apparent to the eye. In either case if the cause of the hunger is found out and satisfied, normal growth and vigour is restored and this is reflected in the yield. Such cases of increased crop yields are abundant in the literature. To cite a few examples, Harmer (Mich. Agr. Exp. Sta. Bull. 314, 1941) reported a 10 bushel/acre increase over control in the yield of potatoes grown on manganese deficient soil receiving a liberal application of $MnSO_4$. A 50 % increase in the yield of barley was obtained at Corny Point by the application of 14 lb. of manganese sulphate per acre. (Rpt. Waite Agr. Res. Inst., South Australia, 1933-36 pp. 48-90. An increase in yield from 7.16 to 14.3 tons/acre of sugarbeets with a dressing of 20 lb. of borax/acre on a Wisner silt loam has been reported by R. L. Cook (Soil Sci. Soc. Amer. Proc. 5, 227, 1940). The spraying of citrus orchards with zinc sulphate in California and of pineapples with ferrous sulphate in Hawaii is now a standard fertilizer practice.

Under certain soil and climatic conditions the amounts of these elements absorbed by the plants from soil is not enough to supply the normal requirements. Alkali, overlimed, calcareous, strongly acid, highly leached, eroded, sandy and peaty soils are likely to be deficient. Such soil conditions are not uncommon in India. In fact, replies to a questionnaire circulated to various States through the I.C.A.R. by Dr. J. N. Mukherjee point to the widespread nature of these deficiencies in our crops and soils e.g., boron in cauliflower and Virginia tobacco in Gorat near Baroda; zinc in paddy and boron in maize and wheat in Bihar; magnesium in *bhendi* (*Hibiscus esculentus*) in Ernakulum, Cochin; magnesium and manganese in sugarcane in Saran, Bihar; copper in tomato and born in cauliflower in Calcutta; magnesium in citrus in Assam; zinc in betelnut in Bombay; boron in cauliflower in Calcutta; magnesium in citrus in Assam; zinc in betelnut in Bombay; boron in

nitrate, manganese in sugarcane and zinc in sweet orange trees in Allahabad Agricultural Research Institute fields; zinc or copper and manganese in sweet orange trees in Madras, and manganese and boron in tapioca and manganese in sesuvium in Travancore. Again the contemplated increased use of nitrogenous or other fertilizers (a desirable practice to produce bigger and more profitable yields) would cause a heavier drain of micronutrients from our soils with the result that they might become limiting factors in crop production. Micronutrient deficiency in our soils is, therefore, to be expected and investigations on soil conditions in relation to deficiencies or yield of crops are worthwhile.

Top yellowing of gram (*Cicer arietinum*) in the I. A. R. I. farms at Delhi and Karnal and the leaching or interveinal chlorosis of citrus trees in Madras and Coorg have been under investigation for a number of years. The latter work started in the Physical Chemistry Laboratories of the University of Calcutta under Prof. J. N. Mukherjee and was later transferred to I. A. A. I., New Delhi in 1946-47.

Except where specified, composite soil samples have been used for analysis.

Materials and Methods In the case of plant samples materials of approximately the same physiologic age were collected, dried at 75°C and ground in an agate mortar. Analysis of these soils and plant tissues for water constituents were done follows Piper's methods (Soil Analysis, 1947). For estimation of micronutrients in both soils and plants Holmes method (Soil Science, 52, 1948) was used. For a comparative idea about total soluble salts in the samples Specific Conductivity of 1:5 soil extracts was determined. Unglazed earthenware pots of 28 lb. capacity coated with 'bituros solution' were used for pot-culture work. There were 4 plants per pot and 5 pots per treatment. Diagnostic injections were carried out according to the method of Reacht (Ann. Bot., Lond. (N. S.) 2, 155, 1959). The diagnostic spraying of small twigs with solutions of various micronutrients mixed with lime and a spreader (Agrol. I. C. I.) was made with a plastic nasal sprayer.

Yellowing As the name implies the symptoms of the disease are : The growing tips of the plants turn yellowish which are then bleached to cream colour with age. Later some of these leaves dry out also. All the lower leaves, however, retain their normal green colour. Growth of the plants gets retarded and the yield suffers. The disease appears in the field in more or less patches. Mycological examination of the roots of plants showed no pathogenic organisms to be associated with the roots. Analysis of soils from healthy and diseased areas (Table Ia) failed to show any difference between them. Analysis of the plant material (Table I b) however, showed that % ash and contents of P_2O_5 , K_2O and iron are higher in diseased than those in healthy. Compared to healthy samples, the content of manganese was markedly lower in the diseased.

Some of the fields where top yellowing is noticed are known for their rising salt patches. In view of this pot culture work with soils from areas where in the previous year healthy and diseased plants were found growing, was undertaken. The treatments were : (a) soil from healthy area (control); (b) soil from healthy area in contact with a water table at 10" below the surface; (c) soil from healthy area + 0.04 % salt of the composition as found in the diseased soil thus making the total soluble salt content to 0.1 %; (d) salt added soil same as in (c) but with a water table; (e) soil from healthy area + 0.14 % salt to make the total soluble salt to 0.2 %; (f) soil from diseased area and (g) soil from diseased area with a water table. Gram var N. P. 35 was sown. Water

table treatment was given when the plants were a few inches high. It was found that plants in treatments (a), (4), and (7) were generally healthy. The plants in the 0.2 % and series started to become yellow from the bottom. The youngest leaves later died, but the tops remained green. This is evidently due to soil injury. The plants in treatments (5), (6), and (2) i.e. where water table was given developed distinct top yellowing symptoms within 15 days. On removal of the water table the plants gradually recovered. This has now been repeated for two seasons. It appears, therefore, that the cause of top yellowing is the air-water imbalance in the root zone of the crop. The lower manganese content of the diseased leaves might be due to absorption of more iron (Fisher & Trane Elements) under the reduced conditions prevailing. Further work on the actual estimation of total pore space, or total and available manganese, iron and iron in soil is in progress.

Mottling The chlorosis of citrus leaves called mottling in Madras and or **Frenching** in Coorg is a common disease of citrus trees in these areas. The symptoms observed in both these places were more or less the same—a type of yellow interveinal chlorosis with veins standing out green. The symptoms were pronounced in mature leaves, the young ones having only a faint indication. Some of the leaves were also smaller in size. In severe cases, mostly found in neglected orchards which did not receive any cultural and manurial treatments or irrigation during the drier periods, considerable dieback was found. In Hoaradur a few young leaves were also found to have a fine network of green veins in a lighter coloured background. Analysis of soils (Table II, a) from healthy and diseased areas in Belgudi showed that there was practically no difference between them in the major mechanical and chemical constituents. The soils are all heavy to coarse fractions. It is noted, however, that the soils from diseased areas have a little more clay, alkaline, poor in respect of available P_2O_5 , K_2O , and total nitrogen. They have low base exchange capacity and low available manganese (Gherman and Hermann, Proc. Soc. Sci., January 7 1942). But the soils from diseased areas are definitely lower in zinc. The higher content of copper in the surface soil of the diseased area might be due to residues from Bordeaux sprays. In Coorg while the surface soils from Kutta are richer in coarse mechanical fractions those of Hoaradur are richer in clay. All these soils are slightly acid. They also have a low base exchange capacity and are poor in respect of total N, available P_2O_5 , K_2O and manganese, the Hoaradur samples being so. It is noted, however, that there is accumulation of active manganese in Kutta soils beyond 2'. Analysis of leaves (Table II, b) shows that there is not much difference in the healthy and diseased samples between themselves from all these places as regards their major elements constituents except that % CaO is lower in the diseased. But compared to the healthy, the disease leaves from Belgudi and Hoaradur are lower in zinc and Mn, while those from Kutta in Zn and Cu.

In Coorg some diazotomic injections and sprays were carried out with various micronutrients. Response in the form of pruning was obtained from Mn and Zn. It might be mentioned that spraying with a Bordeaux mixture is a common practice in Coorg and the effect of Cu injections and sprays was not likely to be obtained. It may be pointed, therefore, that an excellent correlation is being observed between the contents of micronutrients in soil and those in the leaves with the response to injections and sprays. Further work is in progress.

Analysis of soils.

Description	%	% F	%	%	pH,	total N	%	% H ₆ l soluble	CaO	% available	K ₂ O	B.E.C.		Ex. Ca		Sp. Count
												m.e./	100 gm	m.e./	100 gm	
Healthy	61.42	19.21	8.58	11.46	7.6	0.046	0.080	0.30	0.78	0.031	0.016	8.12	8.80	21.3	21.3	21.3
Top yellowing	61.90	20.03	9.04	9.32	7.5	0.048	0.073	0.25	0.71	0.034	0.014	8.80	8.80	21.3	21.3	21.3

Analysis of plants (shoots).

Description	Ash %	Silica %	P ₂ O ₅ %	K ₂ O %	CaO %	MgO %	Parts per million		
							B	Mn	P
Healthy	9.10	6.59	0.61	2.60	3.48	0.76	34.1	126.2	1660
Top yellowing	10.69	10.63	1.01	3.26	3.22	0.71	28.7	63.6	27.88

TABLE II(a).

Lab. No.	Description of soils	Clay	Mechanical analysis (% air dry basis)				pH	CaCO ₃	Base Ex. Cap. & Ex. Bases m.e./100gm			
			Silt	F. sand	C. sand	Pase E.C.			Ca	Mg	K	
Satgudi, Madras:												
Healthy, free from mottling												
MNS 32	0 — 6"	10.00	5.90	76.60	6.30	7.80	Trace	6.80	3.30	1.70	1.40	
MNS 33	6 —12"	12.30	6.20	74.40	6.70	7.70	"	7.40	4.80	1.80	0.70	
Satgudi, Madras:												
Diseased, mottle leaf												
MNS 34	0 — 6"	14.00	9.50	68.00	7.20	7.90	Trace	7.70	4.20	2.10	0.80	
MNS 35	6 —12"	21.20	11.30	61.00	6.10	7.80	"	9.60	5.50	2.40	1.20	
Kutta, South Coorg, Diseased*												
MNS 54	0 — 6"	13.80	9.30	47.50	23.20	6.30	Trace	8.90	5.70	2.00	0.30	
MNS 55	6 —24"	14.60	11.20	51.10	18.70	5.20	Nil	8.40	3.90	2.70	0.30	
MNS 56	24"—33"	21.50	11.00	41.20	23.10	5.90	Nil	6.50	3.90	1.90	0.30	
MNS 57	33" down	33.40	17.80	34.80	14.30	6.50	Trace	9.80	4.60	2.90	0.40	
Hoaradur, North Coorg, Diseased*												
MNS 64	0 — 9"	29.16	20.24	29.30	20.17	6.00	Nil	9.38	4.76	3.76	0.63	
MNS 65	9 —17"	37.12	11.68	30.25	18.33	6.30	—	9.80	4.76	4.11	0.37	
MNS 66	17"—32"	41.60	14.52	26.50	15.96	6.70	—	10.85	4.76	4.64	0.40	
MNS 67	32"—42"	34.48	13.00	28.55	23.27	6.00	—	11.67	5.42	4.77	0.29	
MNS 68	42"—51"	20.64	12.48	31.80	13.72	6.50	—	7.47	4.45	3.33	0.19	
MNS 69	51"—58"	17.84	11.48	31.30	14.95	6.70	—	7.35	3.67	3.69	0.24	
MNS 70	58"—63"	13.84	13.68	35.60	14.50	7.10	Trace	6.51	3.41	2.78	0.19	

* Corresponding healthy samples n

* Corresponding healthy samples no

TABLE II.(b)

Lab. No.	Description of the sample	% Ash	% SiO ₂	% CaO	% MgO	% K ₂ O	% P ₂ O ₅	Fe	Mn	Zn	Cu
MNC 9	Satgudi orange: Healthy	12.70	0.60	5.40	0.36	2.10	0.97		37.5	22.0	
	Diseased:										
MNC 10	Mottle leaf	10.70	0.80	3.50	0.53	2.40	0.71		10.0	15.0	
MNC 25	Kutta orange: Healthy	12.30	0.98	3.02	1.10	1.82	0.69	199	32.4	8.6	26.60
MNC 26	Diseased: Frenching	8.40	0.94	2.92	1.00	1.53	0.51	121	26.9	0.6	13.30
MNC 31	Hoaradur orange: Healthy	10.25	0.13	4.30	1.60	1.97	0.50	121	36.2	20.4 18.6	13.60 12.50
MNC 32	Diseased: Frenching	10.32	0.10	3.50	0.90	1.91	0.49	155	17.7	12.7	17.40 16.20

Symposium on "Red Rot of Sugarcane."

B. M. GUPTA, Lucknow.

Dr. B. M. Gupta said that periodical epidemics of this disease poses a problem for the Indian Sugar Industry and a challenge to plant pathologists in this country. The fact that several inelent strains of the fungus have been isolated from diseased canes during epidemic years comped with the reported diseonary of the perfect stage of the fungus are indications that it is in the intensive study of physiology and genetias of the fumgers lie penhaps the clue to the whole problem of frequent appearanse of virulent forms of the fungus. As an alternative to periodic replasement of varieties, the speaker thought that systematic testing of various forms of the fungus obtained as a result of intensive study of physiological genetias of the fungus against commercial sugarcane varieties and related gram species with a view to building up a substant genetical material seems therefore indixated. This type of collaboratine work between breeder and pathological is indeed called for if Indian sgar Industry is to be served profitably.

From his own absenuations of sugar belt of sonisiana and adjiosent tracts in the United States the speaker could say that much a plan of investigation outlined as above has already started to hear fruit there. There is no reason arley this plan, being fundamental in nature, could nal bepersued with slytat modificatioos in this country also especially when bath the know-how as well as the technical personnel are available here.

Symposium on animal nutrition and human nutrition in relation to crop planning in India.

SACHCHIDANANDA BANERJEE,

The population of India is increasing at a rate—five to six millions per year. We also do not have enough cattle population to till the field and to give us milk. To feed the increasing human population and also to maintain the cattle population we must have enough food. Unfortunately we are not producing food at a rate commensurate with our needs. ue are spending a large amount of money to import food from other countries. This is interfering with the progress of different river valley schemes and other developmental projects. So we must solve the food problem. If we bring more land under cultivation and use the modern scientific agricultural methods we might increase the yield of cereals and pulses for the consumption of human population but the cattle population will not get sufficient fodder to produce adequate quantity of milk which we need for children and pregnant and nursing mothers. If we grow more fodder we shall not get adequate quantity of food for human consumption and if we do not survive who will maintain the cattle. Human nutrition and animal nutrition are, therefore, closely related and for proper crop planning in India both human nutrition and animal nutrition should be taken into account. Many suggestions have been put forward for solving the problem. Some are of opinion that all useless cattle population should be killed so that the half starved milk yielding cows will get more food to yield more milk. We have to-day in our midst three eminent scientists : Prof. B. C. Guha, a pioneer research worker on human nutrition, Dr. K. C. Sen, an eminent animal nutrition worker and Dr. S. P. Roy Choudbury, a soil chemist of rupute, who will speak on the different aspects of this complex problem and these deliberations will help us to solve the complex food problem facing us to-day.

Human nutrition and animal nutrition in relation to crop planning.

B. C. GUHA, Calcutta.

With 360 million people and about 200 million cattle India has indeed at present a difficult problem to supply both food and fodder. It is, therefore, all the more necessary to prepare and implement an integrated plan in order to achieve the best results. In regard to food production for the population, it is well-known that our deficiency in cereal grains is of the order of 10 % in normal years, while our deficit in the production of other food-stuffs like milk, fish, vegetables, eggs and fruits varies from 200 to 400 %. Crop planning for human consumption, therefore, should also take due regard of production of these protective foodstuffs which are essential for adequate nutrition. This aspect of the matter is often overlooked in our chase after cereals. It should be possible by pursuing a well considered plan to meet India's deficit both in cereals and in these foodstuffs within a reasonable period. India's production of rice per acre is of the order of 750 lbs. whereas the yield in Japan is three times as much. In all other countries, per acre production of rice is greater than in India. By the use of better strains of cereals, supply of water, manures and fertilisers, crop rotation and better farming practices it is possible to increase the yield considerably so as to more than wipe off the deficit. This, however, entails fundamental changes in the existing land tenure system and the introduction of cooperative or collective agriculture on a large scale. This can and should be done. To by-pass this question and to pursue a Grow More Food Campaign is practically a fruitless endeavour.

In regard to the question of fodder, India has far too many useless cattle which have to be disposed of in order that the rest might get adequate nutrition. It is a paradox that India has more cattle per head of the population than anywhere else in the world and yet the availability of milk per capita is one of the lowest. If the cattle population could be brought down to a reasonable number, it should be possible to provide reasonably nutrition from available pasture, to the cattle without their being made to compete with man for food from the land. Introduction of better breeds of cattle which should not be diluted with the poor-quality existing breeds, hormone treatment, feeding of iodised proteins etc. should be considered for increasing the milk yield per cow. Similarly feeding the right type of food to fowls would help greatly in increasing the egg production.

The fact is that provision of food and fodder to men and animals can only be made by impinging on many sectors of national economy and intergrating them into one comprehensive and cordinated plan. This, has therefore, to be a vital part of National Planning. The plan has also to be implemented by coordinating the activities of different Government departments operating under a unified control. If India has to solve her food and fodder problem, she has to "take the bull by the horn" and adopt these constructive revolutionary measures.

Animal nutrition and human nutrition in relation to crop planning in India.

S. P. ROY CHAUDHURI, New-Delhi.

Apart from all round efforts for national planning for animal and human nutrition on all India basis we should plan for the individual farmers, or a single village or a group of villages.

Farm planning for land use depends not only on the needs of the land

but on the requirements of the farmer, his inclination to particular type of farming and the requirements of his life stock and poultry. In India whereas lands have been highly eroded conservation farming would produce more and more grasses and legumes and therefore the farmer would switch on more and more to dairy farming. This would necessitate more marketing facilities for milk and milk products. Also this would necessitate the introduction of cropping schemes introducing grass and legumes in the rotation for fodder. Improvement of existing pastures, wherever possible, should be looked into.

There is a belief that the application of organic manures increases the nutritive value of crops as compared to that produced by inorganic fertilizers. The chemical and animal feeding trial data, however, do not lend support to this idea in general. The work at the Indian Agricultural Research Institute with wheat at the permanent manurial experiments at Pusa indicates that the wheat produced by the application of artificial fertilizers year after year possesses the same nutritive value as the wheat produced by the application of organic manures. However, when phosphate fertilizer is applied to wheat the percentage of phosphate in the wheat is some what increased. It has also been established that the application of phosphate to legume increase the yield of the subsequent crop of cereals. The extension officers can easily give out the suggestions to the farmers.

Human Nutrition and Animal Nutrition in relation to Cropplaming in India.

K. C. SEN,

The acute shortage of food stuffs for human beings and livestock over a number of years and the imperative need for self-sufficiency as early as possible have brought us to the unpleasant conclusion that all is not well with our production methods. Numerous reasons have been given for this sorry state of affairs, but it is not necessary to go into the details now. What is more important is to assess the possibility of our ever becoming self-sufficient in matters of food, keeping in mind the gradual and inevitable increase in our population, and the steps that are to be taken to ensure this self-sufficiency within a reasonable period.

The population of India is increasing at a rate which is not very different from certain other countries, such as U.S.A. or Australia, but in the latter countries, there is sufficient land to provide for the requirements of a much greater number of people, which is not the case with India. The approximate figure of 350 millions in this country is likely to increase to a figure of 375 millions in the course of the next 10 years inspite of our current attempts at population control, but we should be satisfied if we can stabilise our population at that figure. This population will consist of men, women and children of all ages whose food requirements will vary to a great extent. An analysis of the requirements of these different age groups has given us a factor of 0.8 by which the total population of 375 millions could be multiplied, so as to give us a figure for adult consumption units. This is equivalent to about 300 million units, each unit requiring approximately 2,700 calories net per day on the average for adequate nutrition. An expert committee consisting of nutritional workers in India has recently calculated the requirement of a balanced diet as 14 oz. of cereals, 3 oz. of pulses, 10 oz. of assorted type of vegetables, 3 oz. of fruits, 10 oz. of milk, 2 oz. of sugar and jaggery, 2 oz. of vegetable oil and ghee, 3 oz. of fish and meat and

an egg per head per day. An estimate based on these figures show that our annual requirement of cereals will be about 43 million tons, pulses 9 million tons, green vegetable 30 million tons, milk 31 million tons, sugar and jaggery 6 million tons, and fruits 9 million tons. The current production is much less in every case, cereals alone being short by about 5 million tons, a slightly higher production of which along with some more of the vegetables, fruits, milk and other quality items might ease the situation considerably.

Most of the food items belong to vegetable sources and must be grown on land. Even in the case of foods of animal origin, such as milk, meat and eggs, their production in the final analysis depends on the availability of land. From the fundamental stand point, therefore, it is the carrying capacity of the land which will determine the level of nutrition of the people. Where the ratio of the arable land to population is high (over 2), such as in U. S. A., Canada, Australia or Newzealand, the level of nutrition is high; in countries where this is much lower than 1, the nutritional level is bound to be low, unless food is obtained by import. This is the case with Britain which has to import 60-70 % of her food requirement. Her 32 million acres of arable land will not support a population of 50 millions unless supplemented by a large scale import of foreign food stuffs, if the present standard is to be maintained.

It will be interesting to consider the land position in our country and then to assess the future possibilities. The net sown area in the Indian Union is about 228 million acres, of which roughly 38 million acres are double cropped. For case of calculation, we can consider the acreage at present cultivated as 266 million acres which gives a figure of about 0.7 as the arable acreage per capita of the population. As has been mentioned before, this is a very low figure and it is no wonder that we are constantly faced with a difficult food situation. Importation of food will be necessary as long as we are not able to put more land under cultivation so as to increase the proportion of arable land in terms of the population. Since the population will also continue to grow in the meanwhile, mere increase in the area of the cultivable land, which in any case is bound to reach a limit soon, will not meet the shortage, but a more intensive production from the land already available will be needed to meet the future requirements.

A study of the land position of the Indian Union leads us to the belief that by proper husbanding of our resources, it is possible for us to produce sufficient food for maintaining our anticipated population at a moderate level of nutrition. This is practicable by adopting the following procedure : (a) By increasing the net area sown from about 228 to 273 million acres. This increase can be brought about by reclaiming 45 out of about 92 million acres classified as cultivable waste; (b) by increasing the area to be sown more than once, from about 40 to 110 million acres. This augmentation is considered possible in view of the new irrigation projects now under way; (c) by salvaging 17 out of 57 million acres of arable land which are currently kept fallow. The total cultivable land thus will approximate to about 400 million acres and will give a per capita acreage of a little over 1.

It is well known that the average outturn of principal crops in this country is poor. Very high yields have, however, been obtained wherever better farming methods are used. By using improved varieties of seeds, application of manure, irrigation and use of insecticides, it is possible to increase without any undue strain the average production of cereals and millets by 15 %, gram by 25 %, the oil seeds by 10 % and sugar cane by 40 %. There is, therefore, no reason why the

land available for cultivation will not bear the necessary crop burden demanded now as well as in the near future. It is interesting to note that with a similar per capita acreage of land available in Germany during the last war, she managed to maintain a near-self-sufficiency in food at a fairly high level of nutrition. To achieve the same success, we need a determined plan of action for (1) land transformation by reclamation, irrigation and manuring, (2) consolidation of holdings, (3) improved methods of agriculture at all stages, (4) intensive and regional specialisation in crop production within an all-India basic plan for crop production and (5) larger and more efficient power supply for all types of agricultural operations.

The power to cultivate land in this country has devolved on animal labour. Perhaps, for many years to come, animal labour will continue to be the main motive power for agricultural operations. Obviously, the area under cultivation will depend on the number and capacity of our working animals, the total number and capacity of our working animals, the total number of which is about 65 millions. Under the existing conditions of feeding and management, the average capacity of cultivation per pair of bullocks is about 10 acres, or 28 million pairs can cultivate about 280 million acres. By better feeding and management, the working capacity can be improved by about 20 %, so that the maximum total acreage that can be cultivated by animal power will approximately be 336 millions. The rest of the potentially available acreage may have to be worked by mechanised power.

The condition of our livestock population presents a picture of sheer neglect, so far as their feeding and management are concerned. Apart from the working bullocks already mentioned, we have about 61 million milch cattle and about 56 million young stock, but due to uncontrolled breeding and poor feeding, the efficiency of our milch animals is very low. This directly affects the nutrition of the human population. In any attempt to reorganise our agricultural system, it is of the utmost importance to consider the requirements of our livestock population (including goat, sheep and poultry) which will on one hand provide nutrition in the form of milk and meat and, on the other hand, support the entire agricultural operations by their labour. In other words, a definite acreage must be reserved entirely for growing food for animals so that their productive efficiency can be maintained at a high level.

The considerations mentioned above have led us to suggest the following allocation of our potentially available arable acreage for different types of production: (1) 290 million acres for the production of human foods of vegetable origin, (2) 83 million acres for the production of foods of animal origin and (3) 27 million acres for the production of commercial crops. Out of the 290 million acres of food crops, 164 million acres can be devoted to cereal crops producing 43 million tons, 40 million acres for gram and pulses producing 9 million tons, 9 million acres for fruits and vegetables producing 12 million tons green leafy vegetables, 9 million tons root vegetables and 9 million tons fruits, 4 million acres for sugar cane producing 6 million tons of sugar and jaggery and 73 million acres for oil seeds which will produce at least 4.25 million tons of edible oil. The 27 million acres allocated to commercial crops will include the increased requirement for cotton and jute production, in addition to other minor cash crops, such as tea, coffee, tobacco etc. The 83 million acres devoted to the production of human foods of animal origin will include the raising of ordinary as well as special fodder of about 360 million tons and production of 20.5 million tons of grains. These together with residues of human food and cash crops, such as straws, cakes, cottonseed, bran etc. and grazing will meet the full nutritional requirement for all the livestock. The allocation

of a sizable acreage for the production of animal feeds and fodders is necessary not only to produce the additional amount of milk but also to maintain and improve the working capacity of the bullocks and the heath of the young which will replace the old stock.

The plan as envisaged above provides for the full requirement of cereals, pulses, vegetables, fruits, sugar and jaggery; 75 % of the requirement for oils and fats, full requirement of milk immediately for 20 % of the population (the vulnerable group) and gradually for the rest when low milk producers are replaced by high yielding stock, and the requirement of meat for 55 % of the population. With the improvement of our fisheries, the demand for fish and meat can be adequately met. The question of the adequate nutrition of our human population can thus be solved on a permanent basis if we can take an integrated view of the various facets of the problem. The land resources must be fully utilised and in this, animals will play a vital role for many years to come. They are the power behind the production. Increase in the cultivated area, increase in outturn, supply of organic manure, small scale irrigation and transport, all these will depend on animal efficiency. Once, however, the importance of livestock in our agricultural industry is properly realised and an integrated plan covering the requirements of human and livestock population in relation to crop planning is put into operation, there is every reason to believe that we shall succeed in solving a hitherto baffling problem of how to feed such a large population in our country.

Section of Physiology.

"Etiology of Diabetes"

(a) Role of Acetone Bodies in the Production of Diabetes.

M. C. NATH, Nagpur.

Though more than thirty years have passed since the insulin was discovered by Banting and Best, the actual cause of the diabetes mellitus still remains unknown. Plenty of works have been done on the attempt to explore the possibility of inducing diabetes in the experimental animals and it has been possible to achieve the end to some extent by—

1. Complete or partial depancreatization,
2. Administration of anterior pituitary extract,
3. Administration of certain adrenal cortical steroids,
4. Alloxan injection,
5. Administration of acetone bodies, and,
6. By the development of a scorbutic condition,

Claims have been made regarding the clue for the gradual development of clinical diabetes, but much work has still to be done to arrive at a definite conclusion.

Adiposity and overweight have long been known as the preccursors to diabetes but nothing was known until recently how fat and the products of its intermediary metabolism could be held responsible for such development.

Acetone bodies such as B-hydroxy-butyrate and acetoacetate have been

found, on prolonged injection, to cause hyperglycemia, followed by an initial stage of hypoglycemia, and to bring about a progressing decrease in the glucose tolerance in a large number of rabbits (twenty). These ketone bodies have also the property of causing inactivation of insulin both in vitro as well as in vivo, though initially they have been found to increase the blood-sugar reducing capacity of the pancreas of the treated animals.

The acetone bodies have been found to bring about a reduction in the hepatic glycogen storage as in case of diabetes. Increase in blood urea and blood inorganic phosphate has also been noticed in the animals receiving these substances.

Injection of the Ketone bodies though could not have any effect in increasing the blood ketone bodies appreciably up to about sixty days a gradual increase was noticed afterwards.

In a recent investigation the ketone bodies have been found to cause a marked increase in the pyruvic acid concentration in the blood and urine of the animals which could be checked to some extent by the administration of Vit B₁ to the animals.

A great loss in the concentration of Vit B₁ has also been observed when acetoacetate was kept with it (invitro) at p. H. 7, 2 thus indicating why the requirement of Vit B₁ in diabetes is very high.

That the Acetone bodies can also bring about a reduction in Vit C in the blood has recently been noticed. This will also explain how Vit C is evidently very low in diabetes.

Because deficiency of Vit C causes glycosuria and hyperglycemia accompanied with reduced glycoase tolerance it is evident that a substance causing such depletion of Via C is definitely one of those factors responsible for the onset of diabetes.

Because deficiency of Vit C causes glycosuria and hyperglycema accompanied with reduced glycoase tolerance it is evident that a substance causing such depletion of Vit C is definitely one of those factors responsible for the onset of diabetes.

Some works have also been done to show how acetone bodies retard the process of transmethylation and exert a great influence in various enzymatic processes.

(b) Vitamin C in the etiology of diabetes.

NARESH CHANDRA GHOSH, Calcutta.

The role of Vitamin C in the metabolism of carbohydrate has been reported by various workers. Diverse opinions also appear in the literature. In order to elucidate the exact relationship, if any, between Vitamin C and carbohydrate metabolism Banerjee studied the glucose tolerance test, glycogen content of the liver, adrenalin contents of the adrenals, and the insulin content of the pancreas of Vitamin C deficient guinea pigs. The investigations revealed that Vitamin C deficiency in guinea pigs leads to diminished glucose tolerance, diminished glycogen content of the liver and diminished secretion of the insulin due to the degenerative changes in the betacells of the islets of langerhans, while the adrenalin content of the adrenal glands increased significantly, Banerjee and Ghosh further showed that the altered carbohydrate metabolism in Vitamin C deficient guinea

pigs was neither due to associated increase in the adrenalin content of the adrenal gland nor due to the hyperfunction of the thyroid gland. Studies with diabetic human patients revealed that the diabetic patients suffer from hypo-vitaminosis C. Some of the patients ceased to excrete sugar in their urine after receiving Vitamin C. These results indicate that the secretion of insulin is dependant on the presence of Vitamin C in the body and the deficiency of insulin will result if proper supply of Vitamin C is not available in the diet. Vitamin C is therefore, might play some role in the etiology of diabetes mellitus.

(c) Role of Glutathione in Diabetes.

BHAVANI BELAVADY, Calcutta.

Glutathione is a tripeptide of glycine, cysteine and glutamic acid being glutamylcysteyl glycine, and is present in the blood and tissues of all animals. Though the protective action of glutathione on many sulfhydryl enzymes and its ability to reactivate inactivated sulfhydryl enzymes oxidised to the disulfide form was known earlier, the prominent role of glutathione in diabetes was recognised only after the work of Arnold Lazarow in 1945, who reported that the injection of a large dose of glutathione, just before the injection of a diabetogenic dose of alloxan, completely protected the rats from diabetes and the dose so needed for protection was within the normal physiological range. In 1930, Campanacci had reported a decrease of glutathione in tissues, particularly in pancreas in human diabetes.

The protective action of glutathione has been understood mostly by studies with alloxan in vitro and in vivo. Glutathione reduces alloxan to the non-diabetogenic dialuric acid and the SH combines further more with alloxan to form a new compound having an absorption spectra maxima at 305 m/μ. This reaction probably needs linkages other than SH since cysteine does not give "305" with alloxan. In vivo studies also reveal that blood glutathione values fall to near about 0, while the tissues show a lesser fall after alloxan injection. Supporting this view it has been found that factors increasing the glutathione content of the body increases the resistance of the animals to the diabetogenic and toxic action of alloxan, while factors tending to decrease the glutathione content increased the susceptibility of the animals to diabetes. Reports have been made of this glutathione factors in other forms of diabetes also.

Coming to human cases, Conn has reported a direct relationship between the blood glutathione and the transitory diabetogenic effect of a purified adreno corticotrophic hormone. Many reports as to decreased blood glutathione in diabetes are found and insulin is found to increase the same of blood and tissues.

Insulin is a protein, having nothing peculiar from the chemical point of view containing 12% cystine, with all the sulfur in the (SS) form. The insulin synthesis decreases the glutathione of the beta cells and staining studies have revealed that the islets of Langerhans have a less reducing capacity which might mean that it has less of GSH and also that its high oxidation reduction potential means a low ability to reduce any toxic substance. It is thus the susceptibility of the beta cells to degeneration by means of alloxan or to other insulin synthesis stimulating mechanism is explained.

Beta cells are thus susceptible to degeneration when the glutathione content is diminished. Alloxan or other toxic substances and conditions which stimu-

late the synthesis of insulin give rise to diabetes because under those conditions glutathione content of tissues are diminished.

(d) Role of Dehydroascorbic Acid in Diabetes.

CHANDI CHARAN DEB, Calcutta.

As corbic acid when oxidised by suitable oxidising agent changes to dehydroascorbic acid. The removal of hydrogen brings about a great change in its biological activity. Ascorbic acid is known to prevent diabetes, dehydroascorbic acid on the other hand produce diabetes. The chemical structure and properties of dehydroascorbic acid is similar to that of alloxan. Alloxan, when injected to animals produce diabetes, the response being a triphasic one. Patterson has produced hyperglycemia in rats on injection of dehydricascorbic acid, increased dose produced permanent diabetes. Like alloxan the response was also triphasic. He postulated that like alloxan it also interferes with the enzyme system of the beta cells of pancreas. Patterson and Lazarow have shown that cysteine and glutathione if injected previously to the injection of dehydroascorbic acid can prevent its diabetogenic action. Banerjee *et. al* observed in rabbits a temporary hyperglycemia and slight reduction of blood glutathione on injection of dehydroascorbic acid. Histological changes in some tissues were also observed by them. In scurvy there is a disturbance in the carbohydrate metabolism. Banerjee, Deb and Belavady have shown increase dehydroascorbic acid and reduced glutathione content of blood, adrenal, pancreas, spleen in scurvy, the change in pancreas being greatest. Dehydroascorbic acid which was found by thme to be absent in normal animals were present in considerable amounts in liver, kidney and small intestine also. This increased dehydroascorbic acid and reduced glutathione content of tissues in general and pancreas in particular was considered by them to be one of the cause of disturbed carbohydrate metabolism in scurvy.

Fermentation Technology.

B. C. GUHA.

In the part the possibility and the economic production of important substances by microbiological means was overshadowed by the great achievements and Synthetic Organic Chemistry. The production and Veat, important B-vitamins and of anti-biotics has shown, however, the practicability of producing very useful compounds by fermentation methods. It is necessary not only to isolate potent strains of lactrine and fungi but also to try to possible more potent instants by artificial methods, like exposurer to ultra-violet ray, x-rays, ultra-somer waves and chemicals.

Fermentation Technology.

DR. KALYAN KUMAR MITRA.

Duplication of Chromosome Complement can be used as a profitable method for the improvement of industrially important microorganisms. Examples were cited from the work done and results obtained at Bayaland Laboratories.

Active collaborative between biologists and geneticist in the one hand and

Chemical Engineers and technologists on the other is essential for any ordered advance in this in this direction.

Fermentation Technology.

Prof. S. RANGASWAMI.

'The discovering of the presence of vitamin B₁₂ in the residual biguors of of Stroptomycin manufacture was based' on a fold Speculation on the part of investigators interested in anti-anaemia factors. This clearly brings out that a reasonable degree of speculation based on sound reasoning may occisionally lead to very terramycin is repiods becoming more and more important, with the advances in our knowledge of the special advaitages resulting from their use in therapy. These will eventually form very large industrial undertakings in field of germentation.

Thus is a quite clear that fermentation techniology offers a very important tation Industries in India by Y. N. Tretian, Secretary of the Biochemical Research Committee of C. S. I. R, last year. He has surveyed the raw materials available in India, the fermentate Indute existing at the present time and various targets of field in the future industrialisation of India.

Fermentation Industries.

Dr. P. S. SARMA.

I wish to draw attention to the very valuable report on Survey and fermen fruitful results and should be encouraged.

The Synthesis of vitamin C on the large scale from glucose involves the conversion of D-Sorbitol into L-sorbose as one of the stages., which is a microbiological process. This vitamin C synthesis is a combination of the chemical and microbiological methods. Thus it is another instance of the use of fermentation methods in the Synthesis of vitamins. (besides the B group vitamins referred to by Dr. Srinivasam).

The manufacture of the more recent antibiotics like aurcomyciha and production in regard to various chemicals obtained by ferentate methods bared on repties received for a comprehension question sent L various bodies all over India Mention may also be made of the important work done at the University Biochem Laboratory and the Unio & Madras on citrfic acid and gluric acid production form a strain and asppuogillu niger isolated in the Unio Botany the efforts and various Satt and other factor have been inventiated.

Fermentation Technology Symposium.

Dr. R. P. PATEL, Ahmedabad

During last two decades, the Fermentation Technology has been developed enoumously in the field of Antibiotics land researches in this field have given us new antibiotics for the treatment of diseases considered incurable before. The

medical profession has thus been supplied with new Antibiotics like Penicillin, Streptomycin, Aureomycin, Bacitracin, Neomycin, Gramacidin, Terramycin etc. to control and treat diseases due to gram positive and negative organisms such as typhus, tuberculosis, yphilis, trachoma, various rickettsial diseases etc.

Sir Alexander Fleming deserved in 1926, the absence of growth of *Staphylococcus aureus* at certain points in a petri dish when cultivated on a Sani media. On clone study, it was found to be due to contamination with a fungus. Further studies revealed that the fungus secreted substances which inhibited the growth of micro-organisms. By 1939, this substance was isolated by chain and florey and clinically studied, where it gave promising cures.

Attempts were, therefore made to prepare this substance economically all over the world. The improvements in the mould by exposure to ultra violet rays, mutation and Polyploidy experiments as well as by studying different moulds have given us to-day a mould with high (1,000 times or more) penicillin producing power. Penicillin *notatum* of Fleming, has been used industrially for penicillin power. Penicillin *chrysogenum* has been found much superior to the original manufacture.

Further improvement in yield was achieved by improving the media in which the mould is gradually addition of Zn, Mn Salts, corn steep liquor etc. by carrying out work at controlled pH and temperature and by adopting a deep culture fermentation process instead of a surface process. This reduced the time of fermentation from 7-10 days to 3-4 days and also the employment of number of workers. This has helped in bringing down the price of penicillin, streptomycin etc., so that it may be used for even the poor.

Sections of Geology, Geography & Botany.

L. A. N. IYER was in the chair,

Microfossils and the Determination of the Age of Sedimentary Rocks.

A. K. GHOSH, Calcutta, opening the discussion said:

The wide occurrence of Tertiary microfossils in the Saline Series of the Punjab Salt Range, has raised a very interesting controversy in Indian geology. Geologists on the testimony of rocks assigned a Cambrian age to the Series. Paleobotanists, on the other hand, on the evidence of a rich angiospermic microflora assigned an Eocene age for the Series. The geologists suggested that the occurrence of such microflora may be due to later contamination and an examination of beds of undisputed Cambrian age, might offer a suitable solution. Two sets of samples of Cambrian rocks of the Salt Range obtained from the Geological Survey of India and Burmah Oil Company (India Concession) Ltd., were examined by the speaker and in all cases microfragments of vascular plants (e.g., wood elements, spores and cuticles) were recorded. These results have been published in *Geological Magazine*, LXXXVIII, pp. 129-132, 1951 and *Transactions of the Bose Research Institute*, XVIII, pp. 71-78, 1949-50. The work was further continued and Cambrian rocks of Sipteh and Kashmir examined. The samples from Kashmir again yielded positive results. Similar fragments have also been obtained from the Vindhya. The technique adopted was the usual maceration method. Sections were also studied.

The occurrence of vascular microflora in geologically known Cambrian and pre-Cambrian beds is not in conformity with the present state of our knowledge of phylogeny of plant groups and the explanation of their occurrence in the beds noted above has to be one of the following hypotheses:

(1) The vascular plants existed the Cambrian a pre-Cambrian times.

(2) The vascular plant remains got into these beds by contamination of fragments derived from beds of younger age.

It is therefore suggested that work be carried out for testing the porosity, permeability and such other physical tests to find out if it was possible for the beds to be contaminated by these minute plant fragments.

A systematic investigation of Cambrian rocks from beds outside India is also suggested for a logical and valid explanation of this problem. The speaker asserted that all possible precautions were taken to avoid laboratory contamination and microfragments recovered from the atmosphere by artificial methods revealed that these are quite different from those recovered from the rock samples. The work has been carried out at 3 different laboratories, viz., Bose Institute (North Calcutta), Geological Survey of India (Central Calcutta) and University College of Science and Technology (South Calcutta), and the results obtained are identical in all the centres.

B. S. Trivedi.

The analysis of Microfossils was fully discussed, stating all the precautions that were taken to prevent the extraneous contamination. Referred to his works jointly with Professor Sahni. Salt and dolomites not so well suited but oil shales best suited rocks for the microfossil work; such micro-fossils can be only in situ and not extraneous.

Referred to the work of J. Hsu in the purple sandstone, who found no plant remains; Dr. R. C. Misra's work, on the Vnidhyans, who also found no vascular plants, but finds Dasycladaceous algae, algae dust and carbonaceous discs.

Referred to Dijkstra's work, who found carboniferous megaspores in the Tertiaries of England: these are redeposited. It is thus possible to find out the redeposited fossils from the in situ ones, when the age gap between them is large as in the Salt Range problem.

Suggested that more evidence should be accumulated before the claim for the existence of vascular plants in the Cambrians can be put forth.

D. C. BHARDWAJ, Lucknow.

Remarked that Mr. A. K. Ghosh has raised two pertinent questions. The first is the principle of microfossils as age indicators of the sedimentary strata. There is hardly any doubt that sedimentary rocks have plant microfossils in them and the question is whether they were deposited during the formation of the rock or have been subsequently introduced. This has been dealt with in considerable details by Prof. B. Sahni and his associates in the 2nd symposium on the Age of Saline Series (Proc. Nat. Acad. Sci., 16, 2—4, 1947). The occurrence of plant-microfossils in the oil shales of the Saline Series is at least one absolute example where the geologists agree that the microfossils contained in them are original and therefore are true age indicators for these shales.

The other issue points to the results of investigation of Cambrian rocks of the Salt Range and Vindhya by Mr. Ghosh wherein he has discovered vascular-plant-remains, quite contrary to the hitherto known belief that vascular plants did not exist below Silurian. With regard to this it was remarked that similar investigations by him, and his colleagues at Lucknow on Cambrian rocks of the Salt Range and the Vindhya, failed to find any vascular plant remains and therefore it was not possible for them to contradict the prevailing view of the geologists. The find of angiospermic remains by Ghosh in Olive shales of Semri series is very startling as Angiosperms are not supposed to have been evolved before upper Jurassic in view of the fossil data available.

It was also remarked that a meagre catch of microfossils from a sample was not a very sure basis for generalisations as in spite of all care, our technique was still not so perfect to preclude all possibilities of contamination from external sources and more so in localities like Calcutta with huge amount of dust, soot and decaying pieces of vegetable matter in the atmosphere at all times of the year. Attention was drawn to Late Prof. Sahni's publication, 'Palacontology and the measurement of Geological time' published in Current Science that the principle of microfossils as age indicators is an instrument which is helpful when used with due caution and extreme care.

In view of this, Mr. Ghosh's findings have to be confirmed by work at different centres. Unfortunately our investigations have failed to corroborate them until now. Unless we have unquestionable and substantial evidence in the shape of microfossils recovered from the rocks by maceration and thin section of rocks the findings of Mr. Ghosh have to be considered with caution.

R. V. SITHOLEY, C. P. VARMA and P. N. SRIVASTAVA, Lucknow,

Several problems arising out of the practical application of the microfossil method are proposed to be discussed,

(1) *Precautions against external contamination* :—Unless one works in a completely dust-free chamber, even the most stringent precautions will not prevent a certain amount of atmospheric contamination. A dust-laden atmosphere so prevalent in most parts of India can carry numerous fragments of cuticles, insect scales, spores etc. Any worker who has some experience in microfossil work should be able to distinguish these from the microfossils genuinely contained in the rock. A certain number of slides should be kept exposed to the laboratory atmosphere and in the open to serve as controls. Contamination acquired by the rocks in the field from prolonged exposure to the elements can be avoided by selecting pieces from the interior of the rock mass and rejecting those which show obvious cracks or fissures, and thoroughly washing the pieces before macerating them.

(2) *Contamination during geological ages* :—Contamination may occur during the geological times subsequent to the deposition and upheaval of the strata, as for example, the presumed contamination of the pre-Cambrian Saline Series with micro-fossils of Tertiary age. Such cases, we think, are best left severely alone by the palaeobotanist. Alternatively, before embarking on the microfossil analysis of rocks of such suspicious character he should take the advice of competent geologists.

(3) *Determination of age* :—The fact needing great emphasis is that

microfossils can give *only a relative estimate of age*. Much of the criticisms of the value of microfossils arise from expecting too much from them.

Plant microfossils have, however, been used successfully in a limited correlation of the strata. They have been used in several countries for the correlation of coal seams. One of the authors of this note was associated in a scheme of microfossil investigation of the oil-bearing Tertiaries of Assam, under the supervision of Prof. Sahni. A fair degree of success was achieved in distinguishing the different series of Oligocene and Miocene strata with the help of characteristic suits of microfossils. Reliable index fossils are scarce among microfossils. They have therefore to be utilised in large groups. Another serious difficulty lies in our lack of knowledge of microflora of the different geological ages.

Some spade work therefore needs to be done on the following lines before micro-fossils can be of real service in age determination.

- (a) A thorough study of the microflora of strata of definitely known ages which have already yielded larger fossils.
- (b) Classification of the micro-fossils so obtained into groups characteristic of each age.
- (c) Search among these groups for index fossils.

(4) Utilisation of data:—As regards utilisation of the micro-fossil data four cases are to be considered:

- (a) The micro-fossils are discovered in large numbers,
- (b) Only a few micro-fossils are discovered.
- (c) No microfossils obtained.
- (d) Conflicting data.

The first (a) is the most desirable situation as it provides the safest ground for deriving conclusions. In the cases of (b) and (c) further attempts to obtain micro-fossils should be made; conclusions based on one or two spores or other micro-fossils are hardly safe. Consistent negative results (c) indicate either very ancient sediments or conditions of deposition under which no plant material could survive. In the case of (d) where the microfossil evidence is in direct contradiction of the established geological and botanical facts and theories, the best course would be first to try to discover the cause of the inconsistency.

The importance of microfossil-study of sedimentary rocks has already been so well emphasised by the late Professor B. Sahni (*Palaeontology and the Measurement of Geological Time, Curr. Sci.*, Vol. 16, pp. 203–206) that it is needless to dwell upon it here. In the case of the apparently unfossiliferous strata to which the methods of age-determination by radioactive estimation are not applicable, microfossils remain the only indicators however approximate, of age.

In the practical application of the microfossil method several problems arise which it is proposed here to discuss one by one.

(1) *Precautions against external contamination*:—No one will deny the need of precautionary measures in the laboratory, during maceration of the rock samples and subsequent operations ending with the preparation of slides for microscopic examination. The precautionary measures can however be carried to extremes, which are sometimes quite unnecessary as the considerations below will prove. Unless one works in a completely dust free chamber even the most stringent precautions will not prevent a certain amount of atmospheric contamination. A dust

laden atmosphere so prevalent in most parts of India can carry numerous fragments of cuticles, insect scales, spores, etc. The only safeguard against these is to know them, and any worker who has acquired a certain measure of experience in microfossil work will be able to distinguish these from the microfossils genuinely contained in the rock. It is therefore of vital importance in all microfossil studies to keep a certain number of slides exposed to the laboratory atmosphere and in the open to serve as controls.

Contamination in the field:—Apart from the atmospheric contamination which is liable to occur in the laboratory there is the contamination acquired by the rocks in the field from prolonged exposure to the elements. This can be avoided by selecting pieces from the interior of the rock mass and rejecting those which show obvious cracks or fissures, and thoroughly washing the pieces before immersing them in the macerating fluid.

(2) *Contamination during geological ages*:—The best of the precautions mentioned above would be of no avail against this. It is the contamination which has occurred in the field, or is supposed to have occurred, during geological times subsequent to the deposition and up-heaval of the strata, as for example the presumed contamination of pre-cambrian Saline series with microfossils of Tertiary age. It is not our intention to challenge the possibility of such a happening. The question has been discussed almost threadbare in the two symposia on the age of the Saline series. But the thought is highly disturbing to the equanimity of the microfossil worker, who while convinced of the efficacy of his tools is given bad material to work upon. Such cases, we think, are best left severely alone by the Palaeobotanist. Alternatively, before embarking on the microfossil analysis of rocks of such suspicious character he should take the advice of competent geologists to find out whether the time and the labour spent by him on them would be worth while.

(3) *Determination of age*:—Once the worker has assured himself of the genuineness of the microfossils discovered by him the question facing him next is how far they would help in estimating the age of the rock. In this connexion the fact needing greatest emphasis is that these fossils can give *only a relative estimate of age*. Much of the criticism of the value of microfossils arises from expecting too much from them. It has to be remembered that plant macrofossils have been known and studied now for more than a century: but the study of microfossils on its present scale is comparatively a very recent matter.

Plant microfossils have, however, been used successfully in a limited correlation of the strata. They have been used in several countries for the correlation of coal seams. Some years ago one of the authors of this note was associated in a scheme of microfossil investigation of the oil-bearing Tertiary System of Assam carried out under the supervision of Prof. Sahni. A fair degree of success was achieved in distinguishing the different series of the Oligocene and Miocene strata with the help of characteristic suits of microfossils. The chief difficulty with microfossils lies in finding among them reliable index fossils. They have therefore to be utilised in large groups or aggregations. Again these groups are based, unlike macrofossils, on entirely artificial systems of classification: so in dealing with them one cannot speak of "element of the flora" in the same sense as with the fossil leaves, stems, fruits, etc. Except in Quaternary pollen which can be identified with the parent plants botanical species are generally unknown among microfossils of older age. Another serious difficulty lies in our lack of knowledge of microflora of different geological ages. We know a good deal, though not as much as we should like to know, of the Devonian, Carboniferous, Jurassic,

Cretaceous, and the Tertiary microfossils. But except for scattered and rather meagre records do we know anything on a similar scale of the contemporary microfossils? Almost every microfossil find is therefore a new find, and because it cannot be identified as a botanical species it must therefore be put away under one of the prevalent artificial systems of classification.

From the above considerations it will be clear that some spade work needs to be done on the following lines before microfossils can be of service in age determination,

- (a) A thorough study of the microflora of strata of definitely known ages which have already yielded the larger fossils.
- (b) The classification of the microfossils so obtained into groups characteristic, within reasonable limits, of each age.
- (c) Search among these groups for index fossils.

It is not implied that microfossil analysis of sedimentary rocks with a view to age determination be suspended pending the completion of the preliminary work outlined above. We would rather that the two be carried out side by side so that we have in the course of time charts of microfossils characteristic of as many geological horizons as possible for purposes of comparisons.

(4) *Utilisation of data* :—A few remarks remain to be added on the utilisation of the microfossil data. There are four cases to be considered :—

- (a) The microfossils are discovered in large numbers.
- (b) Only a few microfossils discovered in proportion to the amount of material examined.
- (c) No microfossils obtained.
- (d) Conflicting data.

The first (a) is the most desirable situation as it provides the safest ground for deriving conclusions. In the case of (b) and (c) further attempts to obtain microfossils should be made; if these also fail conclusions based on one or two spores or some number of other microfossils are hardly safe. Consistent negative result (c) indicate either very ancient sediments or conditions of deposition under which no plant material could survive; they may also tempt one to the assumption of debatable validity, that the organisms existing must have been of too delicate a nature to withstand fossilisation. In the case of (d) where the microfossil evidence is in direct contradiction of the established geological and botanical facts and widely accepted theories, the best course would be first to try to discover the cause of the inconsistency. Assertion on the basis of such data should only be attempted if the worker has very strong reasons for doing so.

R. V. SITHOLEY, C. P. VARMA and P. N. SRIVASTAVA.

The role of microfossils in stratigraphical correlation has already been so well emphasised by the late Professor B. Sahni ("Palaeontology and the Measurement of Geological Time," *Cur. Sci.* 16 : 203-206) that it needs no repetition. For those sedimentary strata in which the larger fossils are absent and for which tectonic and stratigraphic criteria provide little help in assigning them to their proper position within the time sequence, microfossils remain the only possible source to which to turn for information.

The present note discuss some problems which arise in working with microfossils and in their application in estimating the age of the rocks.

PRECAUTIONS AGAINST EXTERNAL CONTAMINATION.

The need of precautionary measures in the laboratory during maceration of the rock samples and the subsequent operations of mounting the material on slides for microscopic examination is obvious. The mechanical measures, however, must be supplemented with a knowledge of the aerial microflora and fauna of the location of the work. Even the most stringent precautions will not prevent some of the micro-scopic objects floating in the air from getting into the material for examination. A dust laden atmosphere prevalent in most parts of India can carry numerous fragments of cuticles, insect scales, spores, etc. The only safeguard against these is to know them; and any worker who has acquired a certain amount of experience in the microfossil technique will be able to distinguish these from the microfossils genuinely contained in the rocks. It is therefore, of vital importance in all microfossil investigations to keep a number of slides exposed to the laboratory atmosphere and in the open to serve as controls. A good deal of extraneous matters may be acquired by the rocks from constant exposure to the elements in the field. Plant fragments and other small objects carried by wind or rain become lodged in crevices. These can be avoided by selecting for maceration pieces only from the interior of the matrix, rejecting all those which show cracks or fissures, and thoroughly washing the pieces with distilled water before immersing them in the macerating fluid.

Contamination during geological ages :—While proper care will eliminate modern atmospheric contamination, the worker dealing with microfossils has to contend with another danger. It has been pointed out that the microfossils recovered from sediments of a plastic or somewhat soluble nature may not be contemporaneous, with their deposition; that some of them, if not all, may be animal or plant fragments that got introduced into the strata during subsequent geological periods—as, for instance, in the presumed contamination of a pre-Cambrian Saline Series with plant fragments of Tertiary age. It is not our intention to challenge the possibility of such a happening. The question is one which should really concern the stratigrapher more than the paleobotanist and has already been discussed at length in the Second Symposium on the age of the Saline Series [*Proc. Nat. Sci. Ind. : 16 (2-4)*]. For the palaeobotanist the obvious course in the circumstances is to select for investigation only those strata which have been pronounced by the geologist to be definitely above suspicion.

DETERMINATION OF AGE.

While plant microfossils can serve as useful accessories, their value in the dating of the rocks is limited. This is partly due to the fact that at present we do not possess sufficient knowledge of microfossils of the different geological periods. The first step, therefore, should be to procure as much data as possible for recognising microfossil assemblages characteristic of the geological areas and periods. Those who have studied plant microfossils know how very difficult it usually is to determine their affinities. Small fragments of woods or cuticles recovered by maceration can seldom be identified with the parent plants

and the same holds true for fossil spores and pollen. A spore or pollen "species" is a unit of variable taxonomic value. Therefore, when the same spore or pollen type appears, as it often does, in several and at times widely separated horizons, it becomes exceedingly difficult to decide whether the specimens represent one species extending over a long period of time or a number of different species of restricted geological range. The criteria for specific differentiation within spores and pollen of living plants cannot be applied with the same degree of accuracy to the fossils, with the result that they have to be sorted into more or less artificial groups for purposes of correlation.

It is to be hoped that with increased knowledge of the micro-floras some of these difficulties will be surmounted. The aim should be to know as much as possible of the natural affinities of the microfossils discovered from time to time. Experience has shown that this is not an ideal easy to achieve. In strata in which the plant micro- and macrofossils occur together the species represented by microfossils usually far outnumber the macrofossil species. In other strata where a rich microflora is present there is no trace of the large fossils. This shows that in the case of a large number of ancient plants the only records left are in the form of microfossils. Thus, except in Quaternary sediments where comparisons may be made with modern plants, the chances of the majority of the older microfossil discoveries being correlated with their parent plants are scanty indeed.

The question of affinity is of major importance where microfossil evidence is the only criterion available for dating the rocks. Many a time, however, information regarding affinity is of no immediate necessity as in correlations of local character. Here the microfossils serve as convenient symbols for determining successive zones within a formation or for tracing the lateral extension of a sedimentary bed. In spite of the comparatively small knowledge we possess of them, microfossils have been employed successfully in this way. They have been used in several countries for the correlation of coal seams. Some years ago one of the authors of this note was associated in an examination of the oil-bearing Tertiary system of Assam for microfossils, carried out under the supervision of Professor Sahni. In this a considerable amount of success was achieved in distinguishing the different series of the Oligocene and Miocene strata with the help of characteristic suits of microfossils.

From the above considerations it will be clear that some spadework needs to be done on the following lines for deriving the fullest advantage of microfossils for the correlation of strata: (i) A study of the microflora of strata of different geological periods, including those which have already yielded the larger plant fossils, and (ii) The grouping of the microfossils into assemblages characteristic of different geological periods, and their sub-divisions.

Utilisation of data—A few remarks remain to be added regarding the utilisation of the microfossil data. There are four cases to be considered: (a) The microfossils are discovered in large numbers; (b) Only a few microfossils are discovered in proportion to the amount of material examined; (c) no microfossils obtained; (d) conflicting data.

The first (a) is the most desirable situation as it provides the safest ground for deriving conclusions. In the case of (b) and (c) further attempts should be made to obtain microfossils or if these fail conclusions based on a few microfossils are hardly safe. Consistent negative results (c) may indicate either absence of plants or conditions of deposition unfavourable to their preservation as fossils. In the case of (d) where the microfossil evidence is in conflict with the stratigraphical

evidence, the best course would be to first try to discover the cause of the inconsistency. Assertions on the basis of such data should only be attempted if the worker has very strong reasons for doing so.

Geography of Crop Plants

SUNIL KUMAR MUKHERJEE, Delhi University.

"Geography of Crop Plants" should include studies on (1) the distribution of crop plants and their wild relatives, and (2) their origin and mode of evolution leading to the creation of numerous variations. The most outstanding work in this line is that of Vavilov in Russia.

In recent symposium on "the Origin of cultivated plants in S. E. Asia" at Delhi under the auspices of the Indian Society of Genetics and plant Breeding and UNESCO it has been suggested by various workers that a number of important tropical crop plants originated in the Indo-malayan region e.g. *Rice*, *Banana*, *Mango*, *Sugar-Cane* (particularly *S. Barberi*), *Brinjal*, *Jute* (*Corchorus capsularis*) etc. (cf. *Ind. J. Genet. & Pl. Breed.*, Vol. 11, No. 1, 1951). The exploration of the areas of the primary centres of origin for these crop plants will enable us to assemble many variations of these crops possessing a large number of genes, which when properly utilized may lead to their improvement. Unfortunately very little work in these lines has been done in our country due to the moribund condition of the

Botanical Survey of India and non-existence of a properly organised Plant Introduction Bureau.

A beginning in this direction has only been made by the Indian Central Sugarcane Committee in organising the "Spontaneum Expedition Scheme" at the Sugarcane Breeding Station at Coimbatore for exploration and collection of wild sugarcane relatives occurring throughout India and assessing their breeding values. The speaker was in charge of the Scheme since its inception and made some useful collections, the details of which have been published in *Ind. J. Genet. and Pl. Breed.* pp. 47-58 (1949) and in the *International Sugar Journ.*, pp. 261-2 (1950). He strongly suggests that similar work should be taken up with other Indian crops in the primary regions of their origin, particularly in Kashmir, Assam, and the foothills of the Himalayas, out of which quite useful collections are likely to be available.

Symposium on the Geography of Crop Plants.

Dr. R. L. NIRULA,

The Geography of Crop Plants has been attracting the attention of the Botanists and some very valuable results have recently been achieved. The important investigations have come from Russia. As compared with U. K. in which the agricultural advancement has mostly depended on one man research stations, in Soviet Russia, Research Institutions with hundreds of workers, have been established and are doing extremely fruitful work. Under the illustrious leadership of Vavilov, a plant breeding programme was chalked out and it was planned to collect every variety of every economic plant from different parts of the world and to see if these different varieties could be grown in the Soviet Union. Very large expeditions were sent out for this purpose and the a number of workers came

over to India as well and took away the different varieties of the various economic plants. The experience of the Russian workers on the different crop plants, in addition to selecting suitable materials for the desirable types in their own country, has been most interesting in regard to the Geographical distribution of the Crop Plants. Previously it was felt that the cultivated plants having been under the influence of man, showed change in their natural distribution and that it was not possible to formulate any definite laws. Vavilov and his associates have, however, established that the laws applicable to the distribution of the wild plants, hold good for the cultivated plants as well. They found out that in regard to every cultivated species, there is a particular centre where there are a large number of varieties and forms and that as one proceeds outwards from the centre, the number of varieties decreases. It was further enunciated that these centres of the greatest diversity are the original homes of the various species in question.

This subject has, further, been helpful in elucidating the problem of the early history of man and diffusion of culture.

Is Evolution Purposive ?

Dr. S. L. Hora opened the discussion by remarking that in his Presidential in his Presidential Address to the Anniversary Meeting of the National Institute of Sciences of India held on January 1, 1952 on "Adaptation and Evolution" he showed how every step in the evolution of the torrential fauna or of an estuarine creek is adjusted to the needs of an organism in a particular environment. He pointed out that the English word "purposive" should not be taken here in any anthropomorphic sense but should mean to indicate that the environment directs certain changes to be effected in the organisation of an individual so as to make it more suitable for its habitat. With the help of lantern slides, he showed the modifications of the swim-bladder in fishes and in the organs of attachment of the hill-stream fishes in response to their respective environments. He concluded that "purpose" in evolution can best be studied in organisms that live in dynamic environments and not in those that live in static habitats.

D. Mukherji, Calcutta.

Dr. Hora's word "Purposive in Evolution" has a dicerent meaning when discussing the theory of Evolution. He has twisted the word to fit in with his idea of adaptation. The question "Is evolution purposive?" is a very old one and proofs in the sense of directive evolution were adduced from Palaeontology from extinct molluscs, and vertebrates as well. The illustrations cited by Dr. Hora are examples of convergences in evolution. Variations arise in chromosomal arrangement and those that are beneficial are put to operation of natural selection.

M. A. Moghe, Nagpur.

Dr. Hora made it abundantly clear that the term "Purposive" is indefinite. He would use the word "direction." The two are not synonymous. One knows that in groups which have been investigated one gets various "directions" along which variation small or large are taking place. These directions are mathematically predicatable. Is there any definite "Purpose" in the occurrence of these "variations" Dr. Hora in describing the adaptive characters of fishes with relation to environment is illustrating one direction in which evolution could be explained

in terms of environment. It may represent a variation which has been selected. The adaptive basis of selection is not denied but it is only one of the many directions in which change are taking place.

We know that some insects resemble other unpalatable *ones*. A question has been asked "why does the unpalatable insect remains stable, i.e., allows the other to resemble it and thus endanger its life"? Now it is known that even the model is changing; therefore it is not only one insect which is varying but both and in these direction we cannot notice any purpose.

In some mammals, the yolk sac degenerates into a gland. But this occurs as a non-adaptive change and further it occurs only in related ones. Why does this change not occur more abundantly?

B. R. SESHACHAR, Bangalore.

I should like to put forward the geneticist's point of view in regard to this important question of whether evolution is purposive.

The great number of examples that Dr. Hora has enumerated of the beautiful adaptations of hill stream fishes which are designed to fit these animals to their highly specialised environment, take me, as they must have taken him when he saw them first, into realms of wonder, and the close and effective blending of the environment and morphological structure no doubt stuck him as a cause and effect phenomenon. The gist of the whole thesis would then be that the physical environment around us determines organic nature. It would mean than any change in environment would immediately affect the organism in some manner. Now, who has a quarrel with that? Has not natural selection produced adaptations of the most astonishing complexity and delicacy? Muller has recently shown the capacity of natural selection to act on differences beyond the power of human comprehension. Time there was when, in the early and initial enthusiasm of geneticists, it was seriously asserted that all existing types of organisms could have come to being without natural selection and genes alone could have produced them.

But the question is not that. It is not seriously doubted that in the great drama of organic evolution, by which I mean the development of new species, two great actors must take the stage, morphological change and environment. But which came first? Is it the environment that created the morphological change which constituted the new species, or did the morphological change come first and adaptation to environment come later? That is the question.

Before proceeding further, it seems necessary to make clear that an organism is not merely a bundle of a number of morphological characters. It possesses a multitude of traits, which, coming under categories of other types, physiological, developmental, behaviouristic and even psychological, never seem related to the environment. I might cite just one example, the antigens of human blood groups which are definitely not related to the environment and which should therefore have arisen in a manner other than as a response to environmental change.

To come back to the hill stream fish. Suppose we accept for a moment, the thesis that the environment created the morphological change. Let us go back to the first fish which found itself in a new environment,—the torrential stream. What would happen to it? Two things: first it would be washed off, because it does not possess the characters which would enable it to exist in its new environment.

Second, it would develop the marvellous structures which Dr. Hora has described. How does it do it? Does it not look too much like the instance of the Giraffe's neck cited by Lamarck? And then what would its offspring look like? This would mean that the new environment has not only an effect on the morphology of the immediate individual but it would affect the germplasm also, for which we have not a shred of evidence. It is true that a very special environment like the existence of highly penetrating radiation has an effect on the genes but there is no evidence at all that ordinary environment as we know it, as we see it and as we feel it, has any effect on the genetic make-up of the organism. The facts of heredity and genetics clearly demonstrate the necessity of recognising particulate inheritance, mutation and sexual recombination as the vital raw materials of which both the harmony as well the diversity which exist in nature are fashioned.

Modern genetics, with its discoveries of the past 30 years, representing a triumph of intellectual achievement and comprehension, has enabled us to grasp fact,—the existence of self-varying organic units, the possession by living matter of the dual property of multiplying both in its constancy and in its variation. The only material that provides the basis for this dual function is the gene complex in the chromosomes. Evolution must therefore embody a change, not from without but from within. It must rest in the transformation, perhaps at a molecular level of a single most important body chemical, the desoxyribose nucleic acid, which makes up the genes. That is the only change that matters, the only change that survives, the only change that determine evolution.

If it is accepted that all mutations must arise from causes within the organism, unrelated to the external environment, it means that the change came first and adaptation to environment came later. If we do see, not only occasionally, but in a large number of instances, the semblance of a purpose, it lies, as Pantin puts it, like beauty' largely in the eyes of the beholder.

A. C. JOSHI, Jullunder City.

It should be remembered that method of evolution in plants and animals differs in many details. Evolution by amphidiploids which is so common in plants appears for example to be proceeding without any purpose except for the force of natural selection. The character of vivipary which serves as a useful adaptation in the mangrove trees on the seashore also occurs in other types of environment and serves no useful purpose there. So evolution appears to have a direction in the broad sense, but it is not always so.

SIVATOSH MOOKERJEE, Calcutta.

Dr. Hora's arguments about "Purposive Evolution" involve a very fundamental aspect of experimental embryology. The word "purposive" begs questions whether it has been meant in an epigenetic or preformation way. The recent experimental evidence, following Spemann's discovery of organiser, has repeatedly demonstrated the epigenetic trends in differentiation. Even reversibility of tissue fate is also possible under certain experimental conditions. The germ layer conception has been shaken to its foundation. So the word "Purpose" in development or in evolution, seems to be unjustifiable. On the other hand if Dr. Hora wants to expound the word "Purposive" in an epigenetic manner then there is nothing

to object with. But "Purposive" always carried the sense of something fixed, limited and happened only to be realised in time. Even there is always a risk which might suggest a denial of animal plasticity and environmental correlations, so universally appreciated by almost all biologists. Thus we will have to define the term "Purpose"; and also what does control it? The purpose of a phenomenon under certain environmental conditions could be changed into something else by upsetting the surrounding media. Dr. Hora's conception of "Purposive evolution" hardly could get any support from the standpoint of the experimental embryologists.

H. KHAJURIA, Calcutta.

There has been a general tendency, in the course of this discussion, to deny the existence of a "direction" in evolution on the grounds that, since the evolutionary changes start with the appearance of certain unpredictable variations or mutations, the evolution is uncontrolled from the very beginning. I would beg to differ from this view. There is considerable evidence to show that the physico-chemical changes in the genes, which express themselves as mutations, are in turn under the control of some deeper causes which are of the nature of extremely complicated and minute changes in the environment. This is, thus, a chain of cause and effect underlying the evolutionary process; and this may very well be compared to a 'directive' force. But to avoid unnecessary argument, it may be better to use the word 'cause' in preference to either 'purpose' or 'direction.' It is important to note that both ends of this evolutionary chain of cause and effect are occupied by the environment; and so the environment as understood in the broadest sense of the word (including all kinds of external stimuli) must be looked upon as the most dominant force which controls or 'directs' evolution. It may be admitted, however, that some links in this chain are sometimes so subtle that it is not possible to demonstrate them by means at our disposal at present.

PUSHKARNATH, Patna.

The speaker at the outset said that the entire question of Evolution is the explanation of heritable variations, which must necessarily be in the genes. If we can explain the reasons of heritable variations we shall have added to the knowledge if evolution is purposive. This has still been kept greatly unexplained in the discussions. Why these heritable variation arise? This is the main question. The geneticists has not much to add but we do know that there are certain external causes, like temperature, even pressure which are known to cause variation which are heritable mutations. The fact remains that it is some external factors, say environment which has caused the genes to mutate; for genes cannot always mutate at their own will without reason. We also would admit that these mutations are random and it is really is the environment which was the primary cause of mutations, and in the process of evolution only such mutation will be selected which will fit in the particular environmental conditions, which were probably originally cause of the heritable variation. There has not been the purpose of changes in environment served by causing disturbance in the genes. In such a event purposiveness or change or changes in environment has been served by causing heritable variations which are first at random and later only such variation would fit in the environment which are adaptive. The purpose has thus been served.

S. L. HORA, Calcutta.

In concluding the discussion, Dr. Hora thanked the participants for their views but remarked that very few seem to have read his Address on Adaptation and Evolution in full. Similar modification is noticed in torrent inhabiting fishes and also in the burrowing fishes of the estuarine creeks. The purpose of such an evolutionary change is the same, that is, to render the fish less buoyant.

There seems to be a general feeling that evolution is based on random variations which have no purpose when they arise. This merely shows that we are ignorant of the environment of the animal or plant concerned. Purpose in evolution can only be appreciated by those who have not only studied the organisms but also the ecological conditions under which they live.

Reference has been made in the discussion to the role of genes in bringing about mutations, which in turn lead to evolutionary changes. But it has been rightly pointed out that genes are themselves affected by environmental changes and that such changes can be directive towards the fulfilment of certain objectives.

Evolution has been rightly stated as an effect of certain causes influencing the animal. The cause and effect interpretation of evolutionary changes seems to be a correct one, for in our studies we have found that the tilting of the Peninsula produced new genera of fishes in the Western Ghats and the periodic rise of the Himalayas has produced certain other remarkable genera. It is thus possible to explain the causes of the evolution of new genera through the effects of these tectonic movements.

Section of Psychology.

Education of Youth

SAROJ KUMAR DAS,

Dr. S. K. Das (Calcutta University) participate in the 'Discussion' by emphasizing at the outset the need of defining the terms 'Education' and "Youth" as the indispensable pre-requisites of a Discussion in an academic setting. Rectifying this omission, he took as his settled point of departure the definition of 'Education' sponsored by Whitehead (the Mathematical Physicist of 'Principia Mathematica' fame and the late Professor of Philosophy at Harvard), which reads thus: "Education is the guidance of the individual towards a comprehension of the art of life. Each individual is nothing but an embodiment of this adventure of existence. The art of life is the guidance of this adventure." Following Whitehead's lead in this regard he went on to remark that all true education 'must be religious—not, however, in a dogmatic or credal sense but in an ethical connotation, inculcating. Duty and Reverence. 'Duty' proceeds from Knowledge that endows us with Power over the present and control over the future course of events; while Reverence springs from the perception that the present contains within itself the sum total of existence, backwards and forwards. Thus neither the traditionalist nor the futurist can possibly impart that educational guidance which the modernist alone can, provided he has a proper sense of values of life. The aim and subject of Education being first determined, we can then redress the somewhat disproportionate emphasis that is being laid in this context on "Psycho-analysis" or "Psychosomatic effects" and thus recover the much-needed balanced outlook on the

point. That alone will enable us to bestow our attention on the importance of "Psycho-Synthesis" rather than Psychoanalysis in the making of an integrated personality. Dr. Das ended by pleading for a whole-hearted acceptance of the human individual from the budding to the full-blown stage, as an embodiment of "adventure of existence."

Education of Youth (Some Suggestions).

(Miss) SUNITI BALA GUPTA.

30 years of my life I have worked as an hunter educationist among young girls and boys in three different provinces. I have come across at least 1 million of young people, 99.99 per cent of whom were normal. I merely tried to classify them as good or bad. Only some of them I found one more socially, merited and some less. But I loved and respected every one of them. I was very fortunate to win their trust and confidence. Whether a Pro-Communist, a Pro-Congressite, a Pro-Muslim League or a Pro-Hindu-Sabhaite—all know that they could come and discuss their problems with me and I would respect their confidence. Thus I could see their world from all angles of vision. From this advantageous position I could find the similar characters on which to build and the dissimilar characters, which would help to develop individuality.

I would like to place before this learned assembly the truths I have gathered from my experience, in a few words,

1. Youths of to-day came into being because youths of yesterday willed it. Through love and that eternal handling of human beings for "immortality" in other words for "perpetual youth," youths came in to being.

2. Youth begins its course like the slender rivulet, which comes from its Snow-white mountain home but courses its way down to the soiled earth, knowing not where it is going. Like the rivulet, youth has been a "Call" the "Call" of the boundless ocean, of which it has no conception.

3. On its way the rivulet meets other rivulets, it gets bigger and bigger until it swells in to a magnificent river rushing with all its tributaries, bearing its rich tributes, to the mighty ocean.

4. The youth like the rivulet can not go back to original home but is perpetually is freshened by the crystal clear contributions of its place of origin. It can not stop on its way, because that would mean stagnations and shameful death. On its way it helps new life, rich creation and riches possibilities.

We do not know when the stream of youth began its course but we know its certain characteristics, which are true of youths of all ages, all places and all variations. These, as noted above, must not be ignored when we try to solve these problems.

(a) Although fundamentally youths of the vedic period had the same characters as the youths of to-day time, location and changes in circumstances have given rise to modifications, which seem to have endowed the youths of to-day with quite different characters from youths of to-day with quite different characters from youths of yesterday. But the characters are not fundamentally different but the results of evolutionary processes.

(b) These characters are not what the child was born with but modifications by environment.

(c) All these evolutionary changes are leading the youths of to-day to

certain end, of which we have no clear-out idea. Like the voyagers they have seen the sivion, fired on the far sea line and they are going towards it—some slowly some rushing to make it theirs.

(d) They do not know the way. So they make mistakes, alter their courses, and these again produce new characters.

(e) Every youth is a unique being. Each being fashions itself with certain colour and shape, but none know how becomes to possess that wonderful gift of uniqueness, which makes him what he is. The world would be very drab and monotonous and uninteresting if the individuals were licked is to same shape. The world is beautiful because her children are fundamentally so much like each other and individually. So much unlike each other.

I huntly suggest that if we bear in mind that this unity indiversity is essential and wholesome, some of our problems will solve themselves.

Education of the Youth.

Miss S. E. RANI GHOSH.

*Summary of the Papper:—*In viewing the Education of the youirth, 3 possibilities face us:—(1) Physical-problems of nutrative food, clothing, proper shelter, which are due to several causes, as effects of wax, curtailment of teritory, abnormal increase if population, vite in forces etc. for which Therafabic treatment is needed (ii) Intellectual—alck of proper educational facillities for the entire youth population, specially for the masses—Adult fanchise is only a nomentature in a democratic state, if education is not wldespread—(iii) Spirtial, which is the heritage of Bharat—A sociological approach is needed for which co-operation if poycologists, educationists and all organisation interested in the welfare of the youth is incertalle. Only a scientific approach to a sociological form of education in a transition period, and a selective altitude of idea is needed best should be the precursar' of a happy state.

Education of the Youth

T. E. SHAMMUGAM, Madras.

The speaker presented his investigations of adolercence boys with a 'Neurotic Inventory' and a 'Projective Technique' known as verbal Projection Test.

Results: The sensaigratification needs were prominent occupying first place with 32.4 per cent. Next in order came recognition need 19.4 per cent. Belongingness need with 19.3 per cent. Affection need with 12.8 per cent. and Achievement need 14.9 per cent.

The influence of Environment on the youths as a whole was frustrating. Chief influences being harm, punishment and theurating. Neutral influences were also prominent. There were favourable influences but were negligible and they were 'Pleasant and dernable'.

The reactions of the individuals suggested mal-adjustment the repanses of frustrations were fairly high, 59.6 per cent. Important reactions were anxiety, fear, unsecurity, unhappiness, sorrow and fallure. Hardship, deprivation and self-punishment were also present.

Suggestion: The needs of youth which are real and essential are not recognized in the present society. Any education of youth should realize this truth and give proper place in the society, allowing remove for fulfilment basic needs in a healthy way.

Plea for a group Therapy to absorb the Pathogenic Propensities.

BIJOY KETU BOSE

Social way of curing maladjustments. Different religious sects with which India abounds affords such opportunities. The concept of Dharma as defined by G. Bose in his interpretations of the Gita also visualizes such a cure. The difficulties of deliberately guiding such therapy and carrying out in practice are immense and require special research before general application.

(b) Education of the Youth.

INDRA SEN,

The youth in India is to-day a problem, perhaps a little more than in the West. But we have to recognise that he is seeking to discover himself under circumstances of much conflict of cultural forces, of transition and growth in the life of the nation, and of general world turmoil and struggle for new values. He is evidently denied the advantage of steady guidance and established values and, therefore, naturally shows conflict, division, violence and revolt in an abnormal degree. But he seeks freedom, wider experience, fresh creation and is prepared to take responsibility. These motivations of his life are highest cultural values and must evidently serve as the best dynamic factors for his education.

We complain of his pleasure-seeking, his picture-going, his indiscipline. But this can be the natural and easiest release from a state of cultural tension and resynthesis, as also a revolt against the religious or relatively ascetic standards of the former order of life. Besides, the scientific civilisation, which itself arose in revolt against religious authoritarianism and asceticism of mediaeval Europe and is to-day the most popular ideal of the world, offers comfort and convenience of living as almost the first value of life.

The parents and teachers of to-day have naturally to understand and sympathise with the present-day youth in order that they may be able to do their duty by him. They have to divest themselves of their traditional expectations and seek to direct and guide him through the actual dynamic factors of his character. In the matter of pleasure-seeking or sex or picture-going or indiscipline he has to be appealed to in terms of freedom, experience, independence, responsibility, consequences. The gain or the loss of these values counts with him and through these he has to be helped to grow in life and character.

Actually he is seeking a new vision of life, and that is what he primarily needs. Pleasure-seeking does not and cannot satisfy the adventure, freedom and independence of youth. It is, in fact, a reaction to religion and an ascetic way of living. Could he but know that an integral life of the Spirit and the Soul within us is neither necessarily tied up with religious dogma nor with an ascetic denial of the world but is in fact a life of the greatest adventure, fullest freedom, completest independence and a most radical change of the world, he might recognise in it

what he is unconsciously seeking. It is, in fact, such a vision of life that was the primary inspiration of Sri Aurobindo and to the working out of which in thought and life he devoted his entire energies. And the success that it has had and in particular, the appeal it has already made to the youth seem to suggest that it might answer to his truest aspirations and give him constructively the way he seeks for the rich enjoyment of the best powers of his body, mind and the soul. And this vision of life may also prove to be the synthesis we generally need to-day, the synthesis and reconciliation of Science and its mastery of external nature with the inner enrichment of life.

(c) Culture Pattern and Behaviour Problems of Youth.

B. R. LUTHAER,

The question "What in a given concrete social set up education of children and youth is supposed to achieve?" needs serious attention. It is necessary to pay serious attention to the nature and functions of the values that we expect the growing generation to imbibe.

As a result of formal education, so far, the study of science and of humanities has remained abstract and the emotional life of youth, primitive. Intellectual dishonesty is one of the consequences of this situation.

It is the broad cultural pattern and its requirements that determine the character of our life in family, neighbourhood and the street—the dynamic factors in our education. By changing the culture pattern and its values the character of these factors too can be changed and a new type of "human nature" can be brought about. In the present day set up the urge to create a rich organized social (and hence personal) life is not induced in children and in the youth. Hence lofty emotions and aspirations are rarely manifested either in feats of heroism or in every day affairs.

Neurosis is a phenomenon secondary to social maladaptation induced by ineffective, lifeless values and ever mounting socioeconomic frustrations. Criminality is a way of releasing the pent-up hostility roused directly by example and indirectly as a reaction against futile suffering, in the absence of any large scale forward looking movement of social amelioration utilising creative energies of youth.

Section of Engineering.

Thoughts on Hirakud Dam Project.

K. B. RAY, (Paper No. 18 or Abstract),

Dr. R. C. Hoon, Dr. N. K. Bose, Dr. K. L. Rao and Dr. G. P. Chatterjee, joined in the discussion.

The remarks of the first music speakers are enclosed.

"Thoughts on Hirakud Dam Project."

N. K. BOSE.

Dr. N. K. Bose, M.Sc., Ph.D., F.N.I., Director, River Research Institute, West Bengal, speaking on the paper of Sri K. B. Ray entitled "Thoughts on Hirakud

Dam Project" said, "I wish Sri K. B. Ray had been present to-day to hear all the facts put up by Dr. Hoon, though as I understand, these had already been shown to Sri K. B. Ray before he wrote the paper. It is not understood how Sri K. B. Ray had forgotten these facts.

Sri K. B. Ray in his paper had laid stress on three points, i.e., (i) proportionality of silt charge with the discharge of the river. It is strange that Sri K. B. Ray, who professes to be a river expert "as he was born on the bank of a river" forgets the basic facts of the river flow that there is scarcely any proportionality of silt charge of different rivers with their discharges. It is well known that some of the rivers carry very heavy silt charge while others carrying almost the same discharge bring down considerably less volume of silt. This is well known to every river engineer. The silt charge of a river does not depend so much on its discharge as on the characteristic of its catchment area. For the same river there is certain proportionality between silt charge and discharge, but, for different rivers this is not correct.

(ii) Sri K. B. Ray has talked of 0.6 depth sample. It is well known that the average point for discharge measurement as well as for silt measurement in a river or a canal is approximately at 0.6 depth of a central vertical. This has been verified at a number of places by various workers. Further, it has been stated by Dr. Hoon that he has taken actual silt observation at a number of points across a river and found 0.6 depth as the average point. It must be admitted that for finding the silt content of a river the more points at which we can take silt observations the better. But, it must be remembered that these observations cost money as well as consume time. The cost of these observations for a river like Mahanadi or Damodar may easily come upto a lac of rupees. If we have to take silt observations at a number of points across either of these rivers the expense might go upto very heavy figure and the time required will also be proportionately long.

(iii) Sri K. B. Ray talked of deposition of sand in the reservoir. The question of deposition of silt sediment on the bed of the reservoir is still mainly an unexplored one. Though a number of observations had been taken in the reservoirs of different rivers in the States as well as in India no very definite information are still available. On basic consideration it may be said that almost all bed sand will deposit at the periphery of the reservoir where the tributaries enter it. The silt that will come down the reservoir will be mostly clay or very fine silt. The pattern of distribution was very clearly illustrated during the last heavy draught in South India. The reservoir in the Caverry river at Krishnaraj Sagar Dam went almost dry during the last dry season and gave an excellent opportunity for studying the pattern of sediment deposition on the bed of the reservoir. It was found that almost all the coarse particles had deposited at the points where the tributaries enter the lake and some fine particles were deposited immediately u/s of the reservoir. Otherwise, the bed of the reservoir was completely free of silt. It was also found that the action of the deep sluices was confined to a very short distance from the dam. The question of silting of reservoir requires careful investigation and it will be worthwhile if provisions are made for such observations in every project estimate for the construction of dams".

Salient Points of the Paper Entitled "Thoughts on Hirakud Dam Project"

K. B. RAY, R. C. HOON, Hirakud.

The anticipated rate of silting up of the Hirakud Reservoir discussed by the author is based on the figure of silt load for a mean year i.e. 42500 foot acres for

a mean annual run-off of 50 million foot acres in the Mahanadi river given on page 31 of the Advisory Committee Report.

It is surmised that annual figure of silt load should have been substantially greater if (i) the silt charge had been actually estimated for a number of years (ii) sampling had not been restricted to 0.6D only but taken at other depths along the sampling vertical and (iii) bed load had also been taken into consideration along with silt load.

On the analogy of the Colorado river in the U. S. A. which carries about $\frac{1}{3}$ the discharge of the Mahanadi but a silt charge of 1,37,000 foot acres, the author argues that the silt charge of the Mahanadi should have been much more or atleast that much as for the former river. Therefore, to lend weight to his argument he prefers the figure of 1,37,000 foot acres instead of 42,500 foot acres for the annual silt charge of the Mahanadi and on that basis computes the life of the Hirakud Reservoir as 33 years.

Further, he considers the figure of 50 percent for the trap efficiency of the Hirakud Reservoir to be an under-estimate and puts it as 100 percent from the experience of sediment deposit in some of the large reservoirs in the U. S. A. and on that basis the life of the Hirakud Reservoir is further halved and put at 16 years.

The effectiveness of soil conservation operations and check dams in the reach of the Mahanadi river above Hirakud Reservoir for reducing further the silt charge of that Reservoir is considered doubtful by the author.

The following comments are offered on the points mentioned above:

1. **Silt data** :—With regard to the routine day-to-day estimation of discharge and suspended silt load of the Mahanadi, we would have full five years data by the end of the current year. A summary of the data collected up till now is given below :

Annual figures of discharge and silt load of the Mahanadi River at Sambalpur for five years (1947-1951)

Year	Run-off in foot acres	Silt in foot-acres			Total	Per cent silt content
		Coarse	Medium	Fine		
1947	39179672	3721.32	4388.41	25130.63	33235.36	0.085
1948	34138582	2661.51	2892.67	23912.64	29466.82	0.086
1949	34814310	2109.89	3028.51	21833.71	26971.91	0.078
1950	34923806	1659.21	3241.57	18711.42	23612.20	0.068
1951*	25084566	769.86	1141.86	19020.37	20932.09	0.083
Mean for five years	33628187	2184.36	2937.56	21921.75	26843.67	0.080

* Based on actual experimental values upto Sept. 51 & mean figures for Oct. to Dec. of the previous 4 years.

Greater bulk of the material comes during the monsoon months by reason of the volume of discharge, velocity of flow and the sequence of floods in that river.

The presumption made by the author of the mean annual silt load at Hirakud exceeding 42,500 foot acres does not seem to be borne out by the five years data given above.

2. *Sampling at six-tenth depth*: That sampling at six-tenth depth was resorted to at the Mahanadi on mere 'assumption' of its being the average sediment load point, as stated by the author, is contrary to facts. Special studies have been carried during this period at a number of sites both at the Mahanadi and the Kosi rivers to bring out the trend of variations of the coarse and medium silt fractions at 0.1, 0.2, 0.3.....0.9 D along the sampling vertical. Those investigations have borne out that the sixth-tenth depth along the vertical does, more or less, approximate to the mean concentration point as far as the charge of the coarse and medium silt fractions in the load at the Mahanadi is concerned. The coarse silt may not be expected to be so grossly in error as the author believes. It is, however, extremely difficult for the staff, employed on the day-to-day testing of silt load at the field laboratories to cope with the work involved in sampling at several depths along the numerous sampling verticals and later analyse such a large number of samples as a daily routine. How the author got the idea that such work was only carried at Kosi and not at the Mahanadi is not indicated.

3. *Bed Load*: It is accepted that no attempt has been made to measure directly the rolling sediment or bed load. As is clear from the literature on the subject, there still exists a serious gap in reference to experimental determination of transport along the bed and the much uncertainty as to its importance. The general conception about sediment transport along the bottom is that this is not significant, the commonest percentages of bed load being those fluctuating between 5 and 20 per cent. A number of valuable qualitative observations have, however, been made by different workers. For instance, it is recorded that transport along the bed increase when the suspended load is less and when the average grain-size of the material in suspension approximates to that of the bed material and a change of any of these factors in the opposite direction tends to lessen transport along the bed. Judged from that standard the amount of bed load may be insignificant as compared to the suspended load as far as the Mahanadi is concerned. In dry season the discharge of the Mahanadi goes so low that the contents of the coarse and medium silt fractions becomes negligible. In that period of low discharge little movement of bed silt can be expected in that river.

4. *Assumption of the Colorado figures of silt load for the Mahanadi*: With regard to the comparison made by the author of the discharges of the Mahanadi and the Colorado, his presumption that as the discharge of the former is three times that of the latter, the sediment load of the Mahanadi should therefore be very much more than 1,37,000 foot acres as recorded for the Colorado, or atleast equivalent to that figure and his acceptance of that figure of 1,37,000 foot acres as the silt charge of the Mahanadi appear ridiculous.

It cannot be argued that if two rivers have almost equal discharge they must necessarily have an equivalent silt charge also. For instance, in our country even though the run-off in the Kosi is hardly 33 per cent more than that of the Mahanadi, however, the silt load of the former is atleast 4 to 5 times that of the latter.

5. *Assumption of the trap efficiency of the Hirakud Reservoir as 100 per cent*: The trap efficiency of reservoirs to retain solids must need by a very variable quantity dependent mainly on operating methods. It may be negligible as at Aswan Dam (Egypt) or at the opposite extremely total. Fairly elaborate

work has been done on the Mahanadi and the Kosi rivers during the last few years to examine the nature of silt in suspension in the river waters during successive freshets by analysing them for their particle-size distribution, fineness etc. With respect to the Hirakud reservoir, the gross and live storage capacities of 6.75 and 4.51 m.a.ft. respectively constitute 13.50 per cent and 9.02 per cent of the mean annual run-off figures of the Mahanadi. Sluices are to be provided at bed level for the full flood discharge and the major flood supplies during monsoon period will be passed below the dam and not stored. There is, however, one difference. At the Aswan Dam there is at present no provision for water power generation and the level of the reservoir is dropped during floods to the normal flood level. At Hirakud there is provision for power generation and a minimum pond level 50 feet above flood level has to be maintained for the purpose. So although at the Aswan Dam there is little silt deposition in the reservoir under present conditions of flood disposal, at Hirakud partial deposition will take place because of a permanent dead pond. As the result of that work it has been brought out that the Mahanadi silt is preponderatingly fine with mean diameter ranging between 0.01 and 0.018. Judged from the nature of silt carried in suspension in the Mahanadi and the special precautions that are expected to be taken to (i) collect the water in the reservoir at the time when the flood water does not have the maximum silt and (ii) its disposal through deep set sluices, it may not be unreasonable to put the trap efficiency of the Hirakud Reservoir at 50 per cent or even lower.

The general experience about the rate of silting in some of the reservoirs has been that it gradually tapers off with time. Moreover, the action of density currents which set up in reservoirs of that size can also be expected to help the disposal of a considerable quantity of the suspended material.

6. *Utility of soil conservation measures and check dams* : The course of the Mahanadi above the Hirakud Reservoir is not very long and the discharge falls off considerably in the upper reaches of the river therefore, the stabilization of the catchment conditions in that reach may not be as expensive as at Colorado. Quite recently, surveys carried to assess the agri-irrigational possibilities of land for two such proposed projects i.e. Upper Mahanadi and Jonk (a tributary of the Mahanadi) have brought out the immense agricultural potentialities of the commanded areas of those proposed dams. The cost of those dams would be more than compensated by the development of the agricultural resources of the areas that would accrue as the result of the provision of controlled water supply there. It is not unreasonable to imagine that the agricultural development coupled with systematic afforestation shall indirectly help to stabilize the catchment condition of the Mahanadi in the upper reaches.

Acid Steel Making in India

P. ANANT.

This paper briefly traces the early history of acid steel making, and in particular, the development of acid steel manufacture in India. With the advent of the second World War, the difficulties encountered in operating the orthodox process of acid steel making, and the resulting development of a new process—Scrap Carbon Process—by the Tata Iron & Steel Co. Ltd., have been narrated and the process described in detail. The paper then deals with the necessity for variations in the above process and the manufacture of Synthetic Pig Iron for the first time in India and working of synthetic pig iron—scrap process for acid steel making

When the demand for acid steel increased, a new unique process—Triplex process—was developed and put into practice at Jamshedpur. The paper attempts to condense the details of the working & chemistry of this process, the various operational problems encountered and their solution, the different methods of finer control employed to ensure the high quality of acid steel. A short description of the Pitside practice is given. The paper then points out the numerous tests carried out on the refractories and the finished steel with corresponding foreign products.

In conclusion, the paper deals with the training of personnel and expresses confidence in the capacity of young men in India, to undertake new ventures, if scope and opportunities are provided.

Acid Steel Making in India.

Historical :

In the Iron and Steel Industry the year 1855 is considered to mark the beginning of an epoch for it was in this year that Sir Henry Bessemer startled the World by obtaining a patent for a novel invention for the manufacture of steel. The process which consisted of converting iron into steel by blowing air through the molten metal, was soon adopted in commercial scale and Bessemer steel soon became tonnage steel. But in order to meet the ever increasing demand for steel, efforts were directed in developing other methods of manufacture. William Siemens in 1861 perfected a regenerative furnace employing gaseous fuel and applied it to the manufacture of glass. Attempts were then made to ascertain the suitability of such type of furnace for the manufacture of steel. In 1868, Siemens proved that regenerative furnace could be successfully operated for steel making and thus developed the Pig and Ore process, the function of ore being to oxidise the impurities in the pig iron such as carbon, silicon, and manganese. The original Siemens furnaces were all acid lined and thus for the first time the acid steel was produced from 100 % pig iron charge. Martin brothers then developed the Pig and Scrap process in which part of the pig iron was replaced by Scrap and thus considerably reduced the quantity of ore required to oxidise the impurities in pig iron. This process was adopted in 1863. Further improvement in the design of the Acid. Siemens furnace was rapid and higher capacity furnaces were built. The term acid is given to this process because Silica an acidic material is mainly used for construction of the furnace and its lining.

Acid Steel Making in India:

In India, the manufacture of acid steel was started initially in 1892 in the Govt. Ordnance Factory at Cossipore, the plant contained a small Siemens Open Hearth Furnace. In due course, the plant was shifted to the present site of Metal & Steel Factory, Ichapore, where production was started in 1905.

This plant consisted of 3 hand charged acid furnaces of 15-20-ton capacity utilising hand fired producers for fuel. In 1928, under a modernisation programme, the plant was dismantled and two new 25-ton acid furnaces were constructed with partial mechanisation of the Gas Producers. All types of shell and alloy steel to ordnance specification are produced regularly in this plant.

Prior to 1939 the acid furnaces in India were operating the hematite

pig and scrap process, the low phosphorus hematite pig being imported from West Coast, England. When World War II was declared, the plant was threatened with a virtual shut down, due to increasing difficulties in importing sufficient quantity of hematite pig iron from abroad, at the sacrifice of essential shipping space urgently required for other purposes. It was at this time that the Tata Iron and Steel Co. Ltd., came forward and developed a suitable and economical process now commonly known as the "Scrap Carbon Process" for the manufacture of Acid Steel from raw materials of indigenous origin. The possibilities of the process were demonstrated at Ichapore by melting scrap containing low Phosphorus and sulphur and employing petroleum coke or any other carbonaceous matter in the charge for recarburising the metal. This process was later on adopted on the 5-Ton acid furnace at Kumardhubi Works. A 25 ton fixed furnace is operating at Kanpur from 1950.

Tata's Steel Melting Shop No. 3.

Further developments resulting in large scale manufacture of acid steel from 1942, took place at Jamshedpur, when a Wheel Tyre and Axle Plant was constructed in the Tata Iron & Steel Co. in 1941, and production of acid steel became a prime necessity for the manufacture of various products in the New Mill. A new melting shop was constructed and put into operation in 1942. This Shop consists of one 25-ton acid lined Converter, one 50-ton Tilting basic lined furnace, one 50-ton acid lined tilting furnace. Acid furnaces are generally of fixed type. There are very few installations in the World utilising tilting acid Open Hearth Furnaces. Once again, the Tatas were the pioneers in employing a tilting type acid furnaces. The furnace charging floor is served by a 5-ton Overhead Charging Crane manufactured by Kumardhubi Engineering Works and the Pitside and Converter Sections are served by two 100-Ton Morgan ladle cranes with 25-Ton auxiliary hoists. The Converter is designed to blow into the Pitside, so that blown metal from the Converters is handled and charged into the furnace from the Pitside. The plant was designed primarily to adopt a unique process of steel making namely "Perrin Process" in which Bessemer Steel was rapidly dephosphorised by Synthetic Slag in a ladle to yield direct steel or dephosphorised metal, and thus provide a source of feed for the acid furnace. Extensive experiments and trials proved the unsuitability of this process and efforts had to be directed in devising other novel methods to meet the growing demands for acid steel.

Fuel :—

The furnaces were originally designed to utilise mixture of Blast Furnace gas and Coke Oven gas as fuel. But due to exigencies of the last War, the huge gas holders had to be deflated and the scheme for using this fuel was abandoned. Therefore, Coal tar, was employed as a fuel for Steel Melting purposes for the first time in India on the Acid Furnace of Tatas. The water cooled burners for the introduction of tar and Coke Oven gas were locally designed. Tar at 75 to 80 lbs/sq. "pressure is atomised by steam at 125 lbs/sq." pressure. Recently locally designed steam super heaters have been installed in the waste gas flue leading to the chimney, to deliver dry high temperature superheated steam for obtaining maximum efficiency of atomisation and for better maintenance of ends of the furnace.

Construction of Furnace :

The construction of the acid furnace is quite similar to that of the basic open hearth.

The entire brick work is (acid) made with silica bricks. The hearth and banks of the furnace are made by ramming and/or fritting good quality white sand. Preparation of the new hearth and bank require a high degree of watchfulness and meticulous care. The physical state and chemical purity of the sand used in the furnace must be periodically checked. When the Acid Furnace was put into operation, repeated trials were made with different kinds of sands available in India. Arrangements were made for the regular supply of sand with 96 to 98 % SiO_2 from Jubbulpore, Madhya Pradesh. But after few years it was found that CaO content in Jubbulpore sand began to increase necessitating extra washing. Further, owing to transport difficulties and rise in the cost of sand, other nearer sources of sands were explored and tested. At present sand from Rajmahal quarries Bihar is used on the Acid Furnace. It was soon realised that control on the chemical and sieve analysis was essential to reduce the time lost on the furnace for fettling and to ensure sound hearth and banks after fritting.

Chemical & Sieve analysis of various sands are given below :—

Chemical analysis of sands :—

Constituents	River Sand %	Mineral Supply %	Ganister %	Jubbulpore %	Rajmahal %	American %	Belgian %
SiO_2	83.60	86.80	91.54	96.60	98.02	96.34	95.80
Fe_2O_3	3.15	2.72	4.20	1.43	0.85	1.05	1.61
Al_2O_3	8.85	8.58	1.58	1.51	0.46	1.60	1.00
CaO	1.30	Trace	0.50	0.25	0.50	0.42	0.59
MgO	0.70	"	0.21				
Loss	1.30	0.90	0.80	0.21	0.17	0.59	1.00

Sieve analysis:—

		Rajmahal	Jubbulpore
Retained on	20 mesh	—	1.40
"	40	56.50	29.20
"	60	21.63	22.40
"	80	14.50	28.00
"	100	5.28	14.50
"	120	& over	4.50

Scrap Carbon Process :

In June 1942, the 50-ton acid furnace started making steel by the scrap carbon process, which is only a refining process in which removal of carbon, silicon and manganese can be controlled but phosphorus and sulphur cannot be eliminated. On the other hand a slight increase is brought about during melting due to concentration. This makes it essential to melt only pure materials containing low quantities of sulphur and phosphorus. The refining is done by oxidation resulting from the addition of pure iron ore, manganese ore and lastly by limestone.

The method of charging is detailed below :

After the furnace is dried and fettled, petroleum coke and/or coke breeze is charged through all doors and uniformly distributed over the bottom and is then quickly covered by scrap. The scrap is charged in lots. When most of the scrap is in the furnace, acid slag collected from previous heats or other slag making materials, to the extent of 2 to 4 % is charged. After the 'clear melt,' the bath is allowed to remain undisturbed till it comes on a boil which indicates that all the silicon and manganese in the charge have been oxidised and that the carbon

reaction has started. The carbon removal is achieved by judicious use of iron ore, manganese ore, and finally by limestone. When the desired carbon is reached, the bath is maintained at equilibrium condition with the help of button sample tests, slag fracture tests and by watching rate of carbon drop. The heat is blocked and alloying elements are added and the heat is tapped out.

The chemistry of the process is discussed later on.

The following typical charge sheet illustrates the working of heats by the Scrap Carbon process:—

Heat No. C—19

"C" Cl. Tyre

Time	Furnace Condition of	Charge & additions	T. C. Q. lbs.				Composition of bath			
			T.	C.	Q.	lbs.	C.	Mn.	P.	S.
13-45	Charging	Petroleum Coke	1	0	0	0				
		Moulding Sand	0	10	0	0				
13-50	"	Steel Scrap	59	0	0	0				
16-0	"	Acid Slag	1	2	0	0				
16-30	Charge finished									
19-0		Acid Slag	1	4	0	0				
21-40	Charge melted									
21-45							1.22	.15	—	—
22-15							1.04			
22-30	Boiling	River Sand	0	0	2	4				
23-00		River Sand	0	0	2	4	0.90	.03	.020	.040
23-20							0.75			
23-35							0.70			
23-40		Silico Pig (25 %)	0	4	0	0				
23-50							0.66			
00-05							0.62			
00-20							0.59			
00-50							0.57			
01-10							0.55			
01-25							0.53			
01-30		Ferro-Silicon (25 %)	0	6	0	0				
01-40		Ferro-Mang. (75 %)	0	6	0	0				
01-45	Tapped In ladle	Ferro-Mang. (75 %)	0	4	2	0				
		Ferro-Sil. (80 %)	0	0	2	16				
	Teeming Skull	Good								
		Bottom	T.	53	6	0				
		Time of heat				12 hours				
Final analysis :—							0.54	.65	.043	.050
							0.54	.64		
							0.54	.64		

Every care should be taken to charge scrap sufficiently low in phosphorus and sulphur. The usual percentages of carbon, silicon, Manganese in the acid cold charge should be as follows :—

Carbon	1 % higher than the finishing carbon.
Manganese	0.5 to 1.0 %
Silicon	0.5 to 1.0 %
P. & S.	as low as possible.

The function of silicon in the charge is as detailed below:—

- (a) The oxidation of silicon is an exothermic reaction and thus facilitates melting of the charge.
- (b) A considerable amount of FeO is produced on melting from oxidation of the scrap by the flame. If there is insufficient silicon in the charge to take care of this FeO, the furnace banks are badly eroded.
- (c) If the silicon does not use up this excess FeO in the charge, the bath melts down wild and the carbon content of the bath becomes lower than the % age desirable at melt down.

The presence of Manganese helps in the formation of proper slag during melting, in reducing the FeO content in slag, and in the formation of ternary compounds of non-metallics.

High Sulphur pick up:—

The first serious problem which confronted the operators was the high % age of sulphur present in the finished steel. The scrap used in the furnace contained Sulphur in the region of .035 to .040 but the Sulphur in the finished steel was about .050. On thorough investigation it was found that the sulphur pick up was largely due to absorption of sulphur from the tar fuel used on the furnace. The following table gives the sulphur content of principal fuels used in the Steel Melting Shops.

Type of fuel:				% of Sulphur.
Coal tar	--	--	--	0.53 %
Coke Oven Gas	--	--	--	0.540 %
Producer Gas	--	--	--	0.68 %
Gas Coal	--	--	--	0.279 %

The average pick up of Sulphur was to the extent of .010 %. There were two solutions for this problem—One was to substitute producer gas for coal tar and the other was to reduce the sulphur in the charge by substituting part of the scrap by materials low in sulphur.

Manufacture of Synthetic Pig Iron :

It was with this purpose that for the first time, synthetic pig iron with low phosphorus and very low sulphur (.015 %) was manufactured on the Electric furnaces. After further investigations and trials, it has been possible to manufacture regularly good quality synthetic pig iron from the Basic Open Hearth Furnaces and cast into pigs in the pig casting machine. Successful experiments on desulphurisation have also been carried out by employing calcium silicide. The analysis of Synthetic pig iron ordinarily in use is given below:—

	C.	Mn.	P.	S.	Si.
Elect. Fce.	3.06	0.50	0.035	.020	0.78
	3.15	0.92	0.040	.014	0.96
Basic O.H.	2.5	1.00	0.028	.022	0.85

Synthetic Pig Iron & Scrap Process :

The replacement of part of the scrap charge by synthetic pig iron resulted in reduction of total sulphur in the charge. Carbon was also introduced in the charge and thus reduced the quantity of petroleum coke in the charge. There

was improvement in the time of heat also. The following charge sheet illustrates the working of heat with Synthetic Pig Iron in the charge:—

Heat No. C—228

Grade — “C” Cl. Tyre

Time	Condition of Furnace	Charge & additions Material	T. C. Q. lbs.				Composition			
							O	Mn.	P.	S.
18-05	Charging	Coke Breeze	0	15	0	0				
		Syn Pig Iron	15	5	0	0				
		Ferro-Silicon	0	6	0	0				
22-25	Finished charging	Steel Scrap	45	6	0	0				
		Moulding sand	0	10	0	0				
		River sand	1	10	0	0				
03-00	Melted Boiling	Slag	0	5	0	0				
03-15							1.10			
03-35		Iron Ore	0	3	0	0				
03-45							0.91	.03	.035	.040
04-00							0.79			
04-15							0.74	.03	.035	
04-20		Limestone	0	2	0	0				
04-30							0.62			
04-45							0.58			
04-05		Ferro-Silicon	0	6	0	0				
		(25 % Sil.)								
05-10							0.48			
05-30		Ferro-Mang.	0	9	2	0				
		(75 %)								
05-35	Tapped. In ladle	Ferro-Sil. (80 %)	0	2	0	16				
		Ferro-Mn. (75%)	0	0	2	0				
		Coke	0	0	1	20				
		Aluminium	0	0	0	9½				
	Teeming Good	Stopper O.K.	Skull	—	Btm.		Nozzle	1.3"		
		Tons :—	55	4	0	0				
	Time of heat		11 hrs.	30 Mts.						
	Final analysis :—						.52	.65		
							.52	.65	.042	.045
							.51	.65	.283	

It is thus seen that introduction of synthetic pig iron in the charge helped to make steel with sulphur content within the specification;

Furnace Maintenance :

The first operational problem encountered in the maintenance of the furnace was the rapid erosion of banks, back and front walls, necessitating shut down of furnace every three weeks for renewal and repairs. There was no information available in the literature and as the furnace was a tilting one employing a new type of fuel, the problem had to be tackled locally by the operators. By careful check up of all analysis, the trouble was traced to the high alumina content of the slag. All aluminous sands (namely moulding sand, river sand, Ganister) used in slag making and acid bessemer slag containing high Al_2O_3 were eliminated from the slag system, resulting in such a marked improvement in the erosion that the front and back wall life was increased to 100 days from 20 days.

Another difficulty encountered during the operation was the rapidity with which the uptakes and Checkers became clogged with fine deposits. These deposits varying from dense sponge at the top to the fine dust at the bottom of the Checkers are formed during the refining period. The waste gases carry the products of combustion and Iron oxide, and while passing through the uptakes and checkers, the FeO is changed to Fe_2O_3 and is deposited in varying size and proportion depending on the fall of temperature. This necessitated a premature shut down of furnace in the past but we overcome this problem by changing the weaving of Checker bricks to enable periodical blowing out of the Checkers with high pressure steam and also by redesigning the furnace structure to allow bigger size uptakes. The critical areas of the furnace were adjusted to take care of the increased products of combustion resulting from tar firing. The roof was raised up and the end coolers redesigned. Further remodelling of the furnace was done recently to incorporate a single large opening to the Slag pockets to enable the removal of deposits by mechanical shovel in one fourth of the time normally taken in the past.

Triplex Process :

In course of time, in order to meet the increased demand for acid steel and also to overcome the difficulty in securing sufficient quantity of segregated pedigree scrap low in phosphorus and sulphur, a unique process was developed and put into practice which enabled the acid furnace to be charged with liquid metal low in phosphorus and sulphur transferred from the basic furnace. The Basic Furnace is charged with converter blown metal with carbon content in the region of 2.50 % or with scrap and hot metal whenever the Converter is out of operation, for the purpose of making suitable transfer metal. It is indeed a great achievement in steel making that a practice was established to reduce phosphorus from 0.35 % to 0.52 % in a high carbon metal charge retaining the carbon in the neighbourhood of 1.5 %.

By maintaining control over the basicity, fluidity and temperature of the slag, it is possible to dephosphorise the high carbon metal; The sulphur in the metal was also considerably reduced with the help of highly basic slag and ferromanganese. Reduction of sulphur by the introduction of manganese ore in the making of synthetic basic slag before charging the blown metal was proved for the first time on the Basic Furnace. When the phosphorus and sulphur is sufficiently low in the bath, the basic furnace is tapped out in a ladle fitted with special arrangement for teeming into the Acid furnace through a 3" ladle nozzle. A hot metal chute was specially designed to lead into the back wall of the acid furnace. Special stopper rigging was designed for teeming at such a height to feed the acid furnace.

The advantages gained from such a process are many. It is possible to obtain very much greater output from the Acid Furnace. The production increased nearly three times. There is no need to segregate and check up the low phosphorus and sulphur content in the finished steel. All grades of steel namely tyre, axle. Boiler quality, spring steels are made from the furnace,

There is of course a corresponding loss of production from the Basic Furnace as the furnaces are required to synchronise operation and one furnace is always utilised to feed the other furnace. But the surplus quantity and better quality and higher price of acid steel compensates to a great extent, the loss of production from the Basic Fce.

Transfer Metal Charge :

In the case of liquid charge, slag cover is provided by charging acid slag from previous heats, half an hour before the transfer metal is charged into the

acid furnace. The decarburisation of the metal in the acid furnace does not start immediately but there is considerable time lag depending on (a) manganese and silicon content of the metal (b) temperature of the transfer metal (c) loss in temperature of metal during transfer. In order to reduce this time lag, the metal from the basic furnace should contain as little manganese and silicon as possible. If there is sufficient volume of equilibrium slag in the acid furnace, low manganese and silicon of the initial metal will not cause any serious corrosion of the banks and bottom. The oxidation of the metal is then governed by temperature, carbon content, and then volume, composition, and viscosity of the slag, and the type of fuel employed. The carbon removal is brought about by three different processes, namely oxidation by furnace gases, direct action of the iron ore and manganese ore on the metallic bath and the interaction of the iron oxide of the slag with the metal.

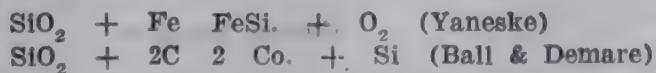
Working of the Heat :

After the residual manganese and silicon have been reduced and the proper temperature has been attained as indicated by the nature of button samples taken out of the bath, the steel is ready to be refined. Iron ore additions are made in order to start vigorous boil and the carbon drop is initiated.

The *ore boil* is absolutely necessary in an acid bath in order to aid the transfer from the metal to slag, of large number of small glossy silicate particles resulting from the oxidation of silicon in the metal. Iron ore addition is made till the carbon content of the bath is 30 points higher than the finishing carbon. After this stage, the slag should be allowed to thicken and thus reduce the rate of oxidation.

It has been found that *manganese ore* tends to give a better working slag. Higher the percentage of manganese oxide in the slag the lower will be iron oxide content of the slag. During the refining of the acid heat, a vigorous action in the bath facilitates the removal of silicate particles. As the rising velocity of a particle of a non-metallic matter in the steel bath is proportional to the square of its diameter, the larger the particle the more rapidly it will rise out of the steel bath and enter the slag. The addition of manganese ore helps the formation of a complex compound made up from SiO_2 , MnO , and FeO . The large globules thus formed have a much greater tendency to rise to the slag during boil than would a small SiO_2 particle.

For limited and controlled oxidation of the bath towards the end of the working of the heat, addition of limestone are made. Acid slag is mainly a ternary system consisting of SiO_2 , FeO , MnO . It is a simple system which is self adjusting. The addition of oxides brings about progressive elimination of carbon until equilibrium is reached. At this stage the SiO_2 content of slag is above 56 % and the slag is thick and viscous. If the temperature at this stage is very high it is possible for the SiO_2 to be reduced and silicon enters the steel. This is usually termed "Silicon reduction."



This reduction of SiO_2 marks a definite point in the slag metal equilibrium. Metal samples taken at this stage distinctly show this reduction. The bottom skin of the sample is marked with holes due to escape of O_2 or Co , while the top skin is smooth and shows slight wrinkles due to surface tension effect. Addition of limestone disturbs this equilibrium. Reduction of SiO_2 is stopped and the following reaction takes place.

$\text{FeO} + \text{SiO}_2 + \text{CaO} \rightarrow \text{CaO} \cdot \text{SiO}_2 + \text{FeO}$ The FeO set free in the slag is thus available for further oxidation. Limestone is free to increase the fluidity of the slag, to encourage gentle dropping of carbon, when the bath carbon is close to the tapping carbon and to clean up the slag and make up the slag volume. The CaO % in finishing slag should be about 5 % with 56/58 % SiO_2 .

The heat is blocked in a similar manner to heats worked by conventional cold charge process and then tapped when the alloy additions in the furnace are through.

Control on Quality:

The problem of inclusions in acid steel has been engaging the serious attention of all steel makers of the World. In order to minimise inclusions in steel the exhaustive investigations reveal that the following points must be carefully studied and rigidly applied in the process:—

- (a) ore boil during working must be brought about to facilitate removal of non-metallics,
- (b) introduction of manganese ore to aid formation of ternary compounds of silicates and transfer such particles from metal to slag,
- (c) correct slag viscosity and thickness and judicious use of limestone and control with the help of Viscosimeters,
- (d) addition of single Silico-manganese ferro-alloy instead of number of other ferro-alloys like (FeSi.FeMn),
- (e) high tapping temperature and holding of ladles before teeming,
- (f) control on the quality of fettling sands.

The above factors govern to a great extent, the quality of steel made in the furnace. In the operation of the acid furnace; all the above factors are rigidly followed. Further in order to perfect the technique and improve the quality every endeavour was made to correlate the final tests on the products at W. T. & A. P. with the making of individual heats. Effects of abnormalities studied. These exhaustive studies and data enormously helped in evolving a standard procedure for the processes. The yield for ingots to finished products at Wheel, Tyre, & Axle Plant was only 43.2 % in 1943 but now in 1950, it was 67.8 % which is more than the expected figure.

In order to ensure finer controls on the production of best quality acid steel, many methods have been developed and standardised on the Acid Furnace at Jamshedpur. The 'working of the heat' is controlled by the help of button samples, the *slag control* is achieved by Viscosimeters, slag cake fracture examination, the *temperature* is governed by film test & immersion pyrometer readings and the furnace operation by installation of various equipment like Roof temperature recorder, automatic pressure and reversing controls. The Pitside practice is discussed later on.

Button Samples:—

In acid steel making, a good button sample is taken as a test of steel quality and when taken at different periods in the working of the heat, indicate the approximate temperature of metal and condition of the bath and nature of reactions taking place at the slag metal interface. Samples representing the reactions in the bath are obtained when the following conditions are fulfilled:—

- (1) Viscosity of slag should be maintained within narrow limits and the

slag should be in completely homogeneous solution as undissolved sand or other fluxes in the slag distorts the shape and smoothness of the sample.

- (2) Slag volume should be uniform and of correct temperature.
- (3) The spoon should be of standard size and should be uniformly slagged before it is introduced in the steel bath.
- (4) Experienced furnace operators with a very steady hand are required for careful manipulation of the spoon.
- (5) The sample after withdrawal from the furnace must be slowly cooled in air.
- (6) Finally the sample must be quenched in cold water.

The theory of button samples is based on the phenomena of surface tension and the reduction of silica from slag into metal. The surface tension is disturbed by the amount of impurities and extent of reaction that is taking place between slag and metal.

The description of button samples taken at different stages at the working of the acid heats is given below:—

- (i) Sample smooth at the bottom surface with a rough top and shine of the appearance of tin. This represents a cold and non-reactive bath.
- (ii) Sample with smooth bottom but rough top and rough edges. This shows that the carbon reaction is proceeding and the bath of steel is not in equilibrium.
- (iii) Sample very smooth at the bottom with slight dimples on the under surface and smooth on the top surface. This indicates the bath nearing equilibrium with temperature rising.
- (iv) Samples smooth at the bottom with deep holes and smooth at the top—bath deoxidised and silicon reduction proceeding.
- (v) Sample smooth at the bottom, but riddled with holes passing right through the samples. Heavy silicon reduction and metal hotter than necessary.
- (vi) Samples perfectly smooth at bottom and perfectly smooth at the top with surface tension ripples *both in perfect equilibrium*.
- (vii) Samples perfectly smooth at bottom and smooth at top with nibbles on the edges—*Limestone in excess in slag*.
- (viii) Samples perfectly smooth at the bottom and smooth at the top with dendritic markings—*very close to equilibrium with a very slight excess of lime*.

Heats are regularly tapped with good samples and it is possible to obtain consistently uniform results by regulating the bath in accordance with the guidance given by button samples.

In the Chemical Laboratory attached to the Melting Shop, the Carbometer is regularly used for quick analysis of carbon. Special type mould is used for taking steel samples for this purpose. The carbon content can be estimated in a couple of minutes with this equipment as against 10 to 12 minutes required for estimation by standard combustion method.

Slag Control:—

Initially the slag control was achieved by employing Fritterer's inclined.

plane Viscosimeter which consists of a steel plate 50" long 6" wide bent to have a 6" horizontal section and a 30" section inclined 30° to the horizontal.

This is set up directly in front of the wicket hole. A spoon full of slag is taken and is rested on the horizontal section and then turned quickly so that the slag runs down the plane. The thickness of the slag at an arbitrarily chosen point 6" to 10" from the horizontal section is measured with a pair of micrometers reading in millimeters. This thickness has been found to be a direct indication of the true viscosity of the slag. In practice it was found that the great disadvantage in this method was the human element necessary in maintaining a constant rate of pouring and the time lag between the time slag sample is withdrawn from furnace and the time the sample is poured over the plate. Later on this method was replaced by Herty's Viscosimeter which consists of steel mould with horizontal section or bore section of $\frac{3}{8}$ " diameter and 10" long. This is fed from a funnel shaped well at one end. The molten slag sample taken from furnace is poured into the well whence it runs through the bore section. The distance the slag traverses along this section, is taken to indicate its fluidity. By this viscosimeter it has been possible to correlate SiO_2 content in slag with fluidity. Similar relationship has been found to exist between fluidity of slag and FeO content of the slag and with the temperature of metal to some extent. As the working of the heat progresses, it is found that the slag fluidity decreases, the SiO_2 content of slag increases, the FeO content of the slag decreases, the MnO content of the slag increases, the slag density decreases, the metal temperature increases. All these factors have shown some bearing on the viscosity tests.

Slag Cake Fracture :—

Slag pan cake samples are taken, cooled, broken and examined. A relation exists between surface, fracture, colour and the soundness of slag samples and the degree of oxidation of the bath. As the slag gets 1 poor in oxygen, the colour of the fracture becomes light olive green and the surface becomes shiny and the fracture is sound without porosity. The higher percentage of manganese in charge considerably influences slag colour generally making it darker.

Film Test :—

Indication about the temperature of metal is given by the film test. For the film test a small spoon is used which should be cold each time the test is taken. The spoon is slagged and the metal sample is taken out of the furnace. As the spoon passes the wicket hole in the door, a stop watch is started. The slag is removed from over the metal and the spoon is gently laid on the floor. The metal is then allowed to film. The time taken for the film is recorded. In practice this test has given very useful indication of the metal temperature.

In the recent past, immersion pyrometers have been obtained from abroad, and the bath temperatures are being recorded with the help of this very fine instrument.

The following instruments have been installed on the Acid furnace for easier and controlled operation of the furnace:—

- (a) Roof temperature recorder (Optical pyrometer).
- (b) automatic reversal of gas based on either Checker temperature difference or time cycle or push button system,
- (c) stack temperature recorder,
- (d) air input in furnace recorder, ..
- (e) furnace pressure control,

The above controls and equipment enable the Staff to operate the acid furnace to produce steel of the best quality.

Pitside Practice :—

Proper handling of steel after tap is very important in ensuring quality of steel ingots produced in the Pitside. All steel intended for the Wheel, Tyre, & Axle Plant and the axle steel rolled into blooms in the Blooming Mill is bottom-poured in a cluster of 6 to 8 moulds per set,

Duo-decagonal bottom-pouring moulds are of 12", 15", 18" and 21" diameter with an ingot length of 94" and with a separate refractory lined hot top of 14 to 15 % of the ingotweight. The Boiler Plate Steel is bottom-poured in cluster of 3 moulds to produce 8-ton ingots. Special construction and assembly for the type of teeming was standardised. Bottom-pouring calls for a large amount of skilled manual work and constant vigilance and supervision in setting, drying the plates and cleaning & dressing of the moulds. The teeming temperature is maintained within narrow limits by estimating the time for holding for ladles after tap, from the tapping temperature. This was possible only after a standard was worked out from a statistical study of the Shop practice data. The tapping temperature is recorded by optical pyrometers. After making a thorough study of over 500 heats and their products, it has been possible to standardise the nozzle size for different sizes of ingot moulds in order to maintain the teeming speeds and to produce bottom-poured ingots with sufficiently thick skin to withstand the enormous pressure at the Wheel, Tyre, & Axle Plant Press. The effect of mould dressing on the ingot surface was studied and by controlling the specific gravity of the medium used for dressing, it is now possible to maintain mould dressing of uniform thickness and to obtain ingots with very good surface. Bunker "C" oil with .92 Sp_g Gr. or coal tar diluted with linseed oil is employed for dressing the moulds.

The quality of refractories used in the bottom-pouring is periodically checked. Tests were also made with imported foreign bottom-pouring bricks and with locally manufactured bricks. Improvements and changes in the analysis of the bricks were made. It is a matter of gratification to report that bottom-pouring refractories of Indian origin are giving very good results and compare very favourably with refractories of foreign manufacture. Sufficient attention is paid to the Pitside practice in order to produce cleaner steel ingots and thus minimise the inclusions in bottom-poured steel. These inclusions on investigation have been found to be due to the refractories used in the ladle and bottom pouring sets, the oxidation and de-oxidation products of steel and the resulting products of the reaction of steel of variable manganese content with the refractories used in teeming. Considerable work has already been done on this problem and further investigations are in progress.

In order to find out the quality of steel produced by the different processes employed in Tatas, as compared to steel produced by orthodox acid steel making practices in England, number of detailed tests were carried out on similar products of English manufacture by the Govt. Metallurgical Inspectorate, Tatanagar. The results indicated that products manufactured from the Acid Steel at Jamshedpur, were not only of the same quality but also in some tests like longitudinal bend tests, the Tata acid steel showed general superiority.

Personnel :—

In England, Europe & America where Iron and Steel industry is well established with sufficient number of experienced hands, it is comparatively easy

to find suitable men for starting a new steel melting shop. But in India the conditions are different. When the new Melting Shop in the Tata Iron & Steel Co. Ltd., started in 1942, no Indian operator with the experience of acid steel making was available. Therefore a batch of young melters with knowledge of basic steel making from the older Shop were picked up and were trained. The new processes were developed locally and very encouraging results were obtained in a very short time.

The excellent quality of acid steel that is now manufactured in India, is indeed an achievement of talent, ingenuity in the handling of men and indigenous materials.

Acknowledgment :—

The author wishes to express his grateful thanks to Mr. P. H. Kutar, General Manager, The Tata Iron & Steel Co. Ltd., for his encouragement and permission to publish this paper.

Effects of Different Limestones on Basic Open Hearth Production.

Mr. Chairman and delegates to the Science Congress.

R. VAILL, H. L. KOCHHAR, L. M. BILLIMORIA, M. KHAN,

It will be my attempt to present the work carried out on, "Effects of Different Limestones on Basic Open Hearth Production" to initiate a discussion and it is left to you to bring out the details you are interested in, either during the course of the discussion here or by going through the actual paper later.

Indian Union is fortunate in having big resources of high grade iron ore, but is handicapped with respect to the quality of limestone and coal, with the result that the problem of a suitable limestone to get high production and good quality steel, is one of the important problems of our steel making. The chemical quality of limestone affects the furnace operation in the following ways :—

1. In case of inferior limestone, a greater amount will have to be used to get a V-ratio of 2.5 to 3 resulting in increased consumption as well as high slag volume.
2. Due to high slag volume, the loss of iron through FeO & Fe_2O_3 in the slag will be more.
3. High slag volume would mean more thickness of the slag layer and thus the passage of heat from the flame to the bath would suffer resulting in low fuel efficiency and increased time of heat.
4. In case of poor limestone heavy feeding of lime would be necessary for working down a high opening Phos or Sulphur and even then it may not be always possible to work it down to the required specifications of the class steels.
5. Due to poor slag resulting from low basicity, the chances of Phos reversion in the ladle would be high, especially in case of high manganese additions in the ladle.
6. A low basic slag would result in more attack on banks and bottoms.

In view of these considerations, the specification for Open Hearth Limestone allows maximum SiO_2 1.0 %; Al_2O_3 1.5 %; MgO 2.5 %; S 0.1 % and P 0.1 %; but the limestone available to the major steel-works in this country shows SiO_2 4.0 to 5.5 % and MgO 3.5 to 4.5 %. This would indicate the gravity of the problem we are faced with.

The Management of our Company on the initiation of Mr. R. Vaidl, decided to carry out exhaustive investigations on this problem at Jamshedpur. It has taken us over two years to complete this work. First small scale experiments were made followed by plant wide test to study the effects on Scrap & Hot Metal Practice as well as Duplex Process. It has been an industrial research but it has yielded facts of academic and scientific interest which may suggest further investigation to other workers. With these hopes this paper is presented to this Science Congress.

Effects of Different Limestones on Scrap & Hot Metal Practice.

Two varieties of limestones were tried, Birmitrapur Open Hearth quality from Orissa & Jukehi Limestone from Central Provinces as the latter was found to contain 0.6 % less Silica and 3.5 % more CaO , and it was intended to find their comparative values to the operation. The factors which were thought to have direct bearing on the production were studied while those which were found to have no economical value were omitted.

It was found that during the use of Jukehi limestone, the time of heat as well as delays on banks and bottoms were reduced with the result that the average production per furnace per hour increased from 6.62 to 7.37 tons. Besides the increase in production, the consumption of limestone was lowered by 15.7 lbs. and lime by 4 lbs. per ton of steel.

For the consideration of shop efficiency in supplying mill orders, only class steels on high demand were considered. It will be evident from the details shown in the paper that during the use of chemically superior limestone, mill orders were satisfied better and the failure due to high Phos were only 6 to 9 % in comparison to 29 to 34 % with a comparatively inferior limestone. The Phos reversion in the ladle was also less.

It follows from these discussions that a chemically superior limestone is of substantial help to the production. It is to be clearly brought out that only superiority in quality is not enough to justify the use of any particular stone for the quality is tied with the price and so the comparative gains have to be carefully worked out.

It was thought that the washing of limestone would result in the removal of impurities coming from the mines and consequently tests were carried with washed local limestone and the gains obtained were similar to those attained with chemically superior limestone. Economical assessments suggested the use of washed local limestone in preference to chemically better limestone from Central Provinces due to high freight cost. A washing tower has been erected and the limestone is washed prior to use in the Open Hearth Furnaces.

Effects of Different Limes on Duplex Process.

For Duplex it is more a question of a suitable lime rather than limestone. Of course a chemically better limestone would yield lime superior in chemical composition. It is to be emphasized that the suitability of lime is not entirely

controlled by chemical analysis and that the physical properties are equally important. The assimilation of lime in the slag depends upon its size and density. Lime floaters in the slag necessitating excessive spar feeding and thus resulting in lowering production are due to big size, dead burning and over-burning of lime. Much cannot be done in this country to improve the chemical composition of lime economically but there are good possibilities for improvements in physical conditions.

Four different types of limestones were tried after processing in a crushing plant installed for these tests. Limestone was crushed and sized $\frac{1}{2}$ " to $1\frac{1}{4}$ " and then calcined in rotary kilns. The results obtained with different processed limestones were mutually compared as well as against unprocessed limestones. These results will be appreciated by study of the graphs shown in the paper (Processing arrangements and graphs will be shown in the symposium if a projector available).

The main findings are as follows :—

1. There was increase in production with the use of lime obtained from processed limestone as compared to unprocessed one.
2. For ordinary plain carbon steels, the production was independent of the chemical composition of limes tried.
3. The consumption of lime was reduced for all the limestones tried after processing, but it also varied with the chemical composition, better quality showing comparatively less consumption.
4. Delays on banks and bottoms also showed reduction with the processing of limestone as well as with improvements in chemical composition.

Lime obtained from the rotary kilns with the sized limestone is superior to the lime obtained from cupolas, due to uniformity in size and better calcination without under-burning or over-burning. It therefore seems that our lime problems would be solved to a great extent through processing of limestone and calcination in the rotary kilns.

Mr. Chairman, Sir, I have presented before the delegates what I wanted to, and it is now their turn to bring out what they wish to.

Effects of Diff Lime Stones on Basic Openhearth's Productio.

S. VISVANATHAN.

ECaO—

1. The use of a formula $\frac{\text{ECaO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3}$ for 'V' ratio appears to be rather

unconventional in that it takes into account Al_2O_3 as an acidic component. There appears to be no Justification to consider it as acidic as the function of alumina appears to be only a diluent as may be seen from our experience with bauxite as a substitute for fluorspar.

2. Cannot the improvement in performance when using limestone after processing be attributed to the reduction in silica content rather than in the uniformity in size ?

Effects of Different Lime-Stones on Basic off Productions.**JITENDRA NATH BARMAN.**

Too much emphasis has been laid in the chemical quality of the L/Stone. The physical quality (not merely the six) viz. age of the L/Stone Deposit, density, compactness etc. has to be taken into account to consider suitability for Iron smelting furnaces.

POWER LINE DESIGN**A Symposium Service Problem on Overhead Transmission in West Bengal.****M. DATTA,**

The following paper is presented before the Indian Science Congress with the object of drawing the attention of the operating Engineers that the existing practices of over head line design, which are largely standardised on the basis of British Practice, have no bearing on the climatic and operating condition prevalent in West Bengal. Modification is considered necessary. It is desired to point out that the modifications, suggested herein are put forward only to elicit public opinion.

The object of regulation for overhead transmission line design is to enable a designer to select and assemble material suitably at site so as to withstand prevailing loading conditions of the place with the necessary safety margin. The provision of an adequate factor of safety to meet the exigencies of circumstances must however be met with.

The conditions at present specified for the Province of West Bengal in the Indian Union* are briefly as follows :—

- (1) no ice loading; (2) temperature range 50° – 130° F; (3) horizontal wind pressure 20 lb/ft^2 calculated on two-thirds of projected area; (4) Safety factor: (a) for conductors (under conditions of maximum loading and minimum temperature) 2; (b) for metal supports (wind pressure 20 lb/ft^2 on $1\frac{1}{2}$ times the area of one face of the support), 2.5; (c) for guard or bearer wires, 3 and (5) minimum height of conductors, 20 ft. from the ground at any point in the span at 130° F. The minimum factors of safety as specified above are those of El. C. 53 for Britain.

The loading conditions of Bengal are, however, not only less severe than in Britain but there is also less difference in Bengal between the loaded and unloaded conditions. The present author recently in an article † in the Electrical Review has shown that the prevailing method of calculating sag and tensions based on the British practice, so long in vogue in this country is uneconomical and a more rational approach to the problem with reference to the particular conditions in this country is necessary. In Britain too, as the result of extended experience, certain modifications of the present code (El. C. 53) are under active consideration*,

A study of the local climatic and geographic conditions is essential for the purpose of planning a Regional Electrification Scheme. Table I—gives the data

*Indian Electricity Rules, 1937, of the Central Electricity Commission, Government of India Press, New Delhi.

†“Power Line Design” (overhead Transmission in West Bengal) by Manoranjan Datta, Electrical Review, 25th May, 1951.

for the normal variations of temperature and the wind velocity in West Bengal. The figures represent the extremes observed over a seven-year period (1941-47) compiled from record of the Meteorological Department at Alipore, Calcutta (22°32'N; 88°20'E, height 20 ft.)

TABLE I. — Temperatures and Wind Velocities.

Shade temp. deg: F.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum	89	94	106	108	108	109	95	97	96	95	92	86
Minimum	47	49	57	66	69	74	75	95	75	67	55	47
Addition for Sun temp. °F.	55	64	63	62	66	71	71	67	66	67	62	65
Maximum W i n d Velocity m.p.h.	45	44	53	62	80	67	69	57	41	67	34	28

It can be found from the above table that during the seven-year period under observation, the shade temperature varied between 47—109 deg.F. The corresponding Sun temperatures are 47 + 55 or 102 deg. F in January and 109 + 71 or 180 deg. F, in June. It should be further noted that the maximum wind velocity occurred in summer months. Meteorological records also show that during the said period on only three days did the wind velocity exceed 70 m.p.h. and that only for a few minutes. The normal wind velocity seldom exceeds 30 m.p.h. The wind pressure for the maximum recorded velocity of 80 m.p.h., is 20.5 lb/ft² (given by the formula $P = .0032/u^2$). For 30 m.p.H., the pressure is only 2.9 lb/ft². It is to be noted that the worst wind load does not occur at times of minimum temperature when the conductor stress is high, but in summer when sudden squalls of short duration may occur. During the low temperature period the wind loading is relatively light.

The present author suggested in his article in the Electrical Review a modified Tension formula:

$L_2 = L_1 - (T_1 - T_2) 1/AE - Ocrl$, where L represents the conductor length for a half-span l, T the tension, A the area of conductor, E the Young's modulus of elasticity, — the difference between the maximum and minimum temperatures: the suffixes 1 & 2 correspond to the maximum loading condition (130°F and 20 lb/ft² wind pressure for West Bengal) and the condition for stringing respectively. For British conditions* the maximum wind pressure occurs at minimum temperature and consequently the sign of the last term in the above equation is positive and this makes a marked difference. As has already been stated, the existing Indian method of calculation for Tension is to copy the british practice.

Table II—given hereto records the comparative results of the stringing tensions of a conductor as calculated by the existing formula and the author's modified formula of a 400 ft. span with a 3/0.147 in conductor (0.05 in² copper equivalent). The conductor weight is 0.20 lb/ft., the windage is 0.53 lb/ft., and the resultant load, including maximum wind pressure is 0.57 lb/ft. The safe working tension (with a factor of safety of 2) is 1460 lbs. the elastic modulus has been taken as 18×10^6 lb/in² and co-efficient of tension as 9.2×10^{-6} per deg: F. (Vide Figs: 1 & 2 annexed).

*"Overhead Line Regulation" by Grimmit, H. W.; Proc. I. E. E., 96 (II), page 673 (1949).

* *Electrical Power* by STARR, A. T. 1937 Edn., page 59—Pitman.

TABLE II.
Tension at erection in Still Air.

Erection Temp. deg. : F.	130	110	90	70	50
Tension lb. :					
Normal formula	590	640	710	780	870
Modified formula	870	980	1090	1220	1310

The figures for tension as found by the modified formula suggest that the conductors may be strung to a higher tension and smaller sag with larger spans than at present and thus a considerable economy may be effected by using support tower of smaller height. With the increased tensions permissible by the above modified formula, it is probable that vibration dampers might be required, particularly if steel-cored aluminium conductors are used;

The author assumed his maximum loading conditions in the above example as occurring at 130° deg: F and 20 lb/ft² wind pressure, whereas the existing method assumes 50°F and 20 lb/ft² as the maximum loading conditions. In view of the fact that in West Bengal maximum wind velocity occurs during the summer months (as can be seen from data in Table—I), the existing method is irrational and uneconomical though it has been strongly supported even recently by the Chairman of the Central Water & Power Commission in a bulletin.

On examining, however, the above modified method suggested by the present author in his previous article, it will be found that the method allows too much tension to be applied to the conductors. Whereas in the existing method no condition can be severer than that stipulated. In the modified method, there may be other condition (e.g. minimum temperature with little wind) where the factor of safety may be lower than that at the maximum temperature condition unless it can be shown that the increase in tension resulting from a fall in temperature will be balanced by the reduction in tension occasioned by reduced loading condition.

It will, therefore, appear that one of the difficulties that are against the adoption of the above views of the author, is that higher tension produce fatigue and failure. This is true as a general principle: but it all depends on what is a likely tension to produce fatigue. Have we enough data to be able to claim that the tensions allowable by the modified formula are above those likely to initiate uneconomically—early fatigue failure?

It is now proposed to deal with the difficulty that may arise as a result of the adoption of the modified method of calculation of tension in conductors and what can be done to get over the same.

Meteorological data reveal that in West Bengal, maximum wind occurs during the month when the temperature is highest; but a sudden outburst of "Thunder Storm" after a bright hot day in summer occasionally causes a sharp fall of temperature (Fig: 3). The fall of temperature may not necessarily be due to rain water but may be due to the arrival of a mass of cold air during such squally weather. The most common fall is about 6°F; the largest fall recorded being 22°F. The majority of storms in which falls of the order of 12°F took place, occurred between 3.7 hrs, and 19 hrs. It may be assumed that probably the highest sudden squall occurs at, say, 80°—85°F, but the temperature of the conductor may be a bit higher due to current and other factors, so that the condition of maximum loading at which the worst wind occurs may be assumed to be 90°F,

*Factors of Safety for Overhead Transmission Line Conductors by Gadkary S. A., and Talwar R. C. Publication from Central Water & Power Commission, 1951.

To maintain a conductor immune to vibration trouble and fatigue failure, a fairly slack tension has to be maintained during average condition that prevails most of the time. This condition may be termed "every day condition," and the American practice is to allow a factor of safety of 4 for such a condition. If we amend our previous modified method further and make the calculation such that the Factor of Safety should be 40 % of the ultimate strength of the conductor for a temperature of 90°F. with wind load and 25 % for 90°F. without wind, vibration troubles are likely to be obviated.

Table—III. (Vide Figs: 4, 5, 6 and 7) shows the results of calculation carried out on this basis.

TABLE III.

Calculation of Factors of Safety for Different Sizes of A.C.S.R. Conductors and Spares at Different Temperatures.

Description	F.S. at 50°F.		F.S. at 90°F.		F.S. at 130°F.	
	New.	Exist	New.	Exist	New	Exist
0.2 Sq. in copper equiv. A. C. S. R. (1000' span)						
With wind	2.18	2.5	2.5	2.83	2.83	3.2
Without wind	2.65	3.24	3.24	3.95	3.95	4.65
0.1 Sq. in copper equiv. A. C. S. R. (600' span)						
With Wind	2.21	2.5	2.5	2.8	2.8	3.08
Without wind	3.26	4.13	4.13	5.1	5.1	6.00
0.03 Sq. in copper equiv. A. C. S. R. (400' span)						
With wind	2.16	2.5	2.5	2.86	2.86	3.24
Without wind	3.1	4.47	4.47	6.51	6.51	8.95

From the results it appears that with this method i.e., on the assumption of maximum wind load at 90°F. (a probable figure), a uniform series of values for factor of safety have been obtained at all temperatures under likely operating conditions viz. little wind pressure at lower temperature and higher wind pressure at higher temperature. Also 'without wind load under every day condition' of tension the values of the factor of safety are in the region of 4 or thereabout. Even if wind load comes at the lowest temperature, the tension will be well within 60 % of the ultimate strength as per American and British Methods.

It is suggested that in West Bengal, the line designs be based on tensions of 40% of the ultimate strength under the conditions of maximum wind when the line conductors are at 90°F. Also final normal tension of conductors at 90°F without wind load (i.e., normal every day tension) be limited to nearly 25 % of the rated conductor strength except for 3 strands, where final normal unloaded tensions of 30 % of rated conductor strength may be permitted. Sag and tension charts based on the limits of conductor tension specified above should be calculated by the use of the modified formula for the range of temperature below 90°F., for range of temperature above 90°F., the existing formula should be used.

N.B. Wind pressure 20 lbs. per Sq' ft. on 2/3 projected area.

The author had experience and opportunities to study the prevailing climate condition in West Bengal with particular reference to their effect on overhead transmission line conductors. But the modifications proposed herein should be good and effective for other parts of India as the "basic conditions" appear too be comparable. The Operating Engineers are certainly the best fitted persons to advise the authorities on this subject.

Service People on overlead Transmission in West Bengal.

AMULYA KUMAR BHAUMIK.

It is true that the Transmission Engineers in India so far were using the British practice in respect of Factor of Safety of conductors without carefully studying the full implications involved therein.

After going through Dr. Datta's article, I am of the opinion that for estimating purposes the existing method would still be convenient and practicable. While preparing detailed estimates for transmission systems, where economy in design will play a considerable part, the point raised by Dr. Datta in effecting the same by adopting his formula, is worth consideration.

Giving some idea as to how this economy can be effected by reducing the Factor of Safety from 2.5 to 2, some calculations were made for a typical conductor size of 15 sq. in. equivalent steel-cored aluminium conductor for a normal span of 750 ft. The increase in maximum sag for the increased Factor of Safety works out to about $3\frac{1}{2}$ ft. The standard tower height will therefore be increased to the same extent. This will increase the cost per tower by about 11 % or Rs. 150/-. The cost per mile of line will be increased by over Rs. 1,000/-.

There is a section of opinion in India which advocates that it is better to have a higher Factor of Safety so as to minimise the vibration troubles in line. As the vibration troubles can be effectively controlled by installing suitable armour rod, stock-bridge or other types of dampers, the increase in cost does not appear to be justified when compared to the slight advantage that may accrue by way of reduced vibration troubles.

Dr. Datta has now suggested that instead of considering the worst loading condition at minimum temperature, the assumption should be made on a more realistic basis i.e. maximum wind loading of maximum temperature actually prevalent in West Bengal on the available meteorological data for last 10 years. It appears from these data that if the basic loading condition is taken at 90°F, it would be possible to effect some economy in the tower design after fulfilling the requisite condition that the conductor should not be stressed more than 50% of its ultimate strength.

The argument of Dr. Datta is really based on the fact, that the basic loading condition must be found out first. Once it is accepted that it should be at 90 or 80°F, as the case may be, the value of 't' (temperature difference) in the sag calculation formula should be taken as plus or minus according to erection temperature is higher or lower than 90 or 80°F.

I am sure that the new idea which Dr. Datta has put forth in his article, will be seriously considered by the Transmission Engineers in our country.

Overhead Trams-lines.

S. V. C. AIYA.

- (1) Theoretical result to be verified experimently.
- (2) Precautions before applying data.
- (3) All India standards are not possible as conditions vary.
- (4) Lack of availability of parts need use of large margin of safety.

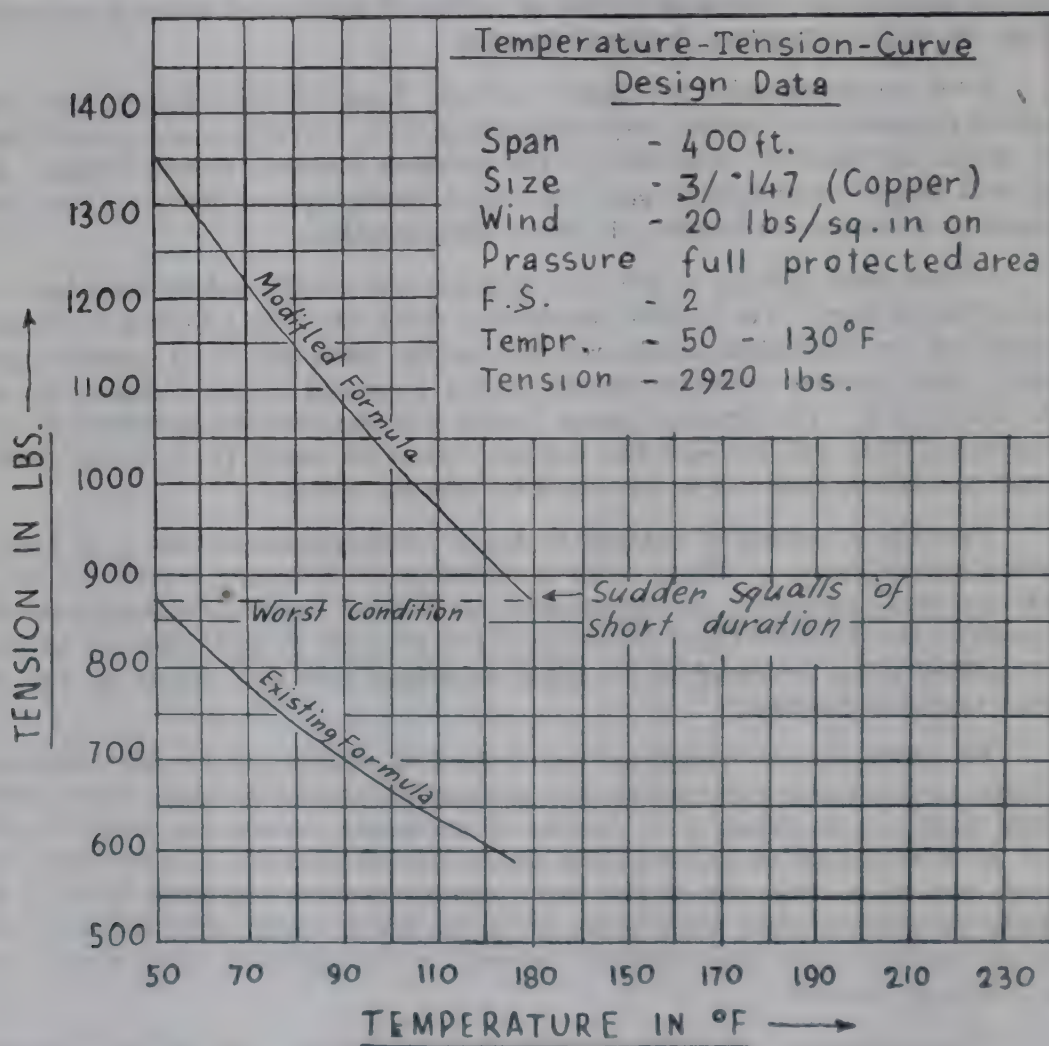


FIG. I

FIG-3 - ALIPORE THERMOGRAPH RECORD 3RD. MAY 1912

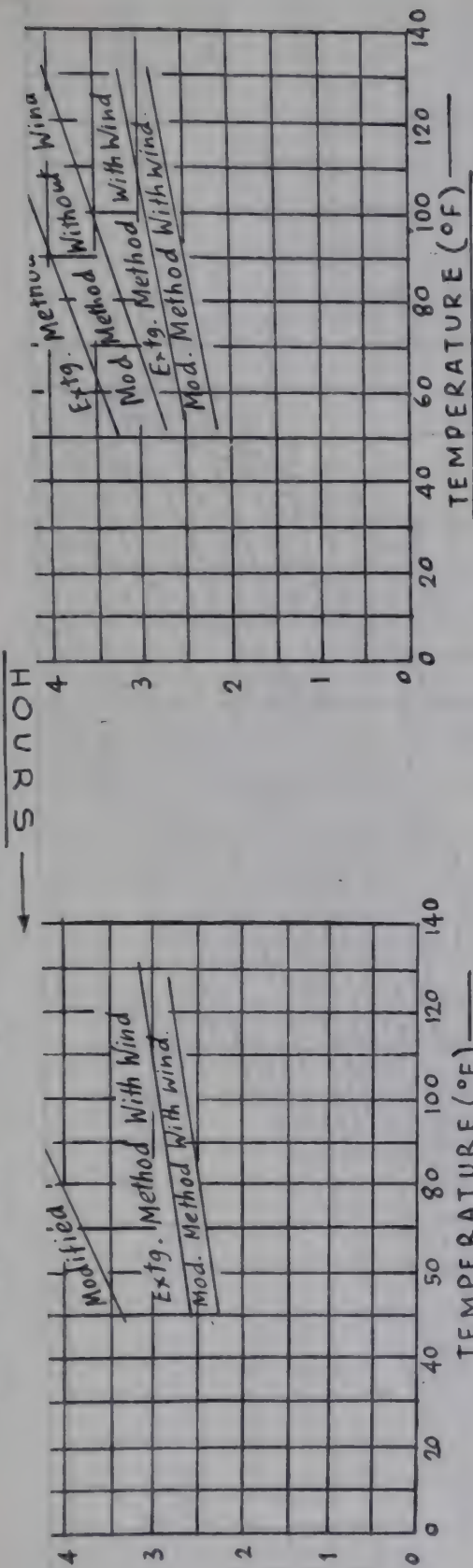


FIG. 4

SIZE : 7/102 A.C.S.R.
Copper Equivalent = .03 Sq. in.

FIG. 5.

SIZE : 7/144 A.C.S.R.
Copper Equivalent = .06 Sq. in.

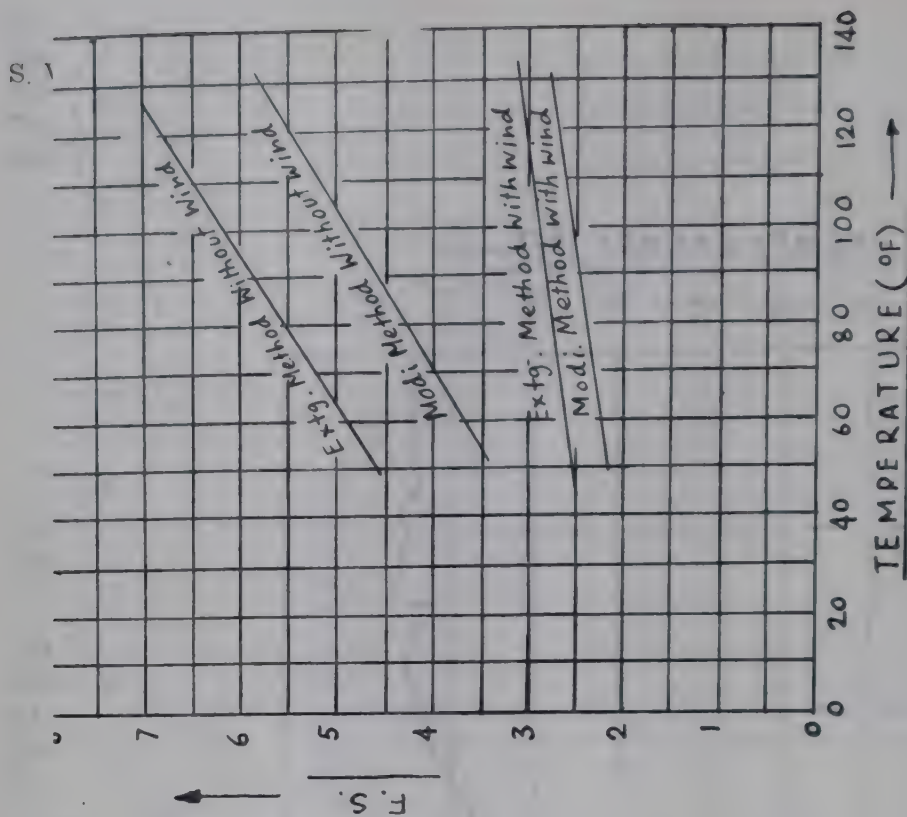


FIG. 7

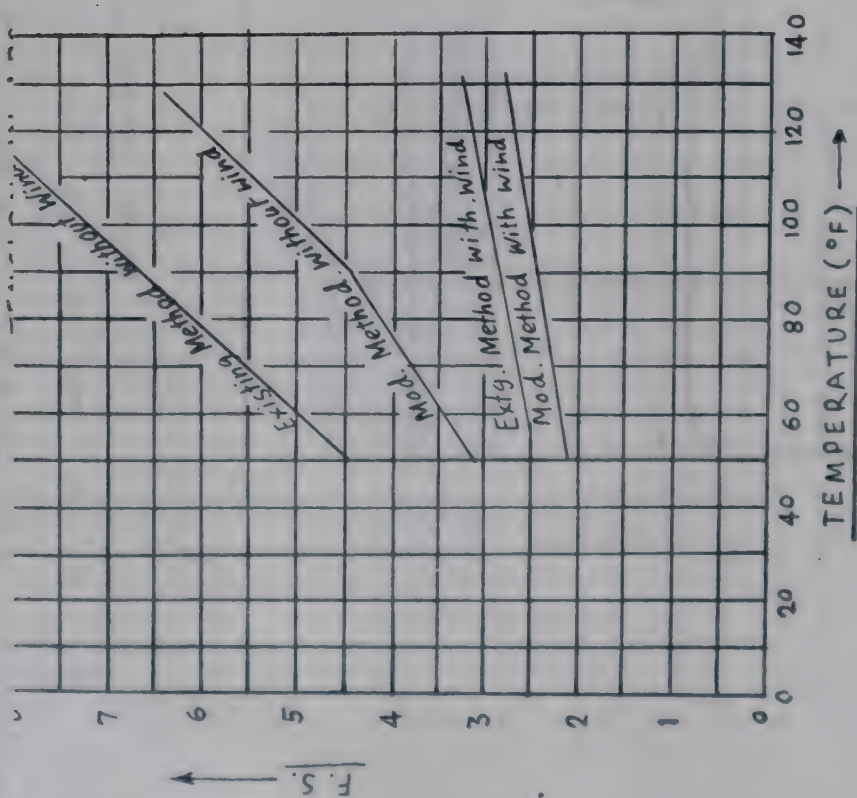


FIG. 6

LIST OF MEMBERS

LIST OF MEMBERS

HONORARY MEMBERS

- Beaufort**, L. F. Dc., Director, Zoological Institute, Amsterdam, Holland.
Hill, A. V., F.R.S., 16, Bishop Wood Road, Highgate, London, N 6.
Jung, C. G., Professor of Psychology, University of Zurich, Switzerland.
Raman, Sir C. V., Kt., F.R.S., Nobel Laureate, Indian Institute of Science, P.O. Malleswaram, Bangalore.
Saha, M. N., D.Sc., F.R.S., F.R.A.S.B., F.N.I., Palit Professor of Physics, University College of Science, 92, Upper Circular Road, Calcutta.
Simonsen, John Lionel, D.Sc., F.R.S., Director, Colonial Products Research, Imperial Institute, South Kensington, London, S.W. 7.
Visvesvaraya, Sir M., K.C.I.E., Uplands High Ground, Bangalore.

BENEFACTORS

- Burmah Oil Co.** (India Trading), Ltd., Digboi, Assam.
Ghadiary, Pestonji, F., F.R.G.S., F.R.S.A., F.B.H.I. (Lond.), M.M.E.A., A.M.A.F., M.I.S.E., Senior Scientific Officer, Engineering Intelligence Service, Delhi.
Tata Iron & Steel Co., Ltd., 'Bombay House', Bruce Street, Fort, Bombay.

ORDINARY MEMBERS

(As at the close of July 15, 1949 (Rule 4). The names of Sustaining Members are marked with † and the names of Life Members are marked with*.)

A

- Abinchandani**, C. T., M.Sc., Ph.D., A.R.I.C., Central Rice Research Institute, P.O. Naya Bazar, Cuttack 4.
Acharya, C. N., M.Sc., Ph.D., D.Sc., F.R.I.C., Indian Agriculture Research Institute, Government of India, Pusa Road, Karolbagh, New Delhi.
Acharya, Dr. K. T., Central Laboratories, Distillery Compound, Narayanguda, Hyderabad-Deccan.
Adatia, R. D., M.Sc., Ph.D., Professor of Biology, Vice-Principal, of M. M. Arts College and N. M. Institute of Science, Nav Gujrat, Andheri, Bombay.
Adeshra, Dr. Priyakant Nagardas, Gandhi Gate Road, Baroda.
Adhikari, A. K., Director, Himatsingka Timber Ltd., 6, Old Post Office St., Calcutta.
Adhikari, N., Assistant Manager (Chemicals), Bengal Chemical & Pharmaceutical Works Ltd., 164, Maniktala Main Road, Calcutta.
Adhya, G. M., B.Sc., F.E. (Wis. U.S.A.), Grad. G. E. Tech. (Mass.), A.M.I.E., Chief Engineer, Hastings Mill Ltd., Rishra, Hooghly.
Adhya, (Miss), C/o. Mr. G. M. Adhya, Chief Engineer, Hastings Jute Mill, P.O. Risra, Hooghly.
Adhya, (Mrs.) Jotirmoyee, C/o. Mr. G. M. Adhya, Chief Engineer, Hastings Jute Mill, P.O. Risra, Hooghly.
Agarwal, P. P., I.C.S., Additional Secretary to the Government of Bihar, Appointment Department, Patna.

- Agarwala, P. M.**, Additional Chief Engineer, Post & Telegraphs, Jubbulpore.
- †**Agharkar, S. P.**, M.A. (Bom.), Ph.D. (Bero.), F.L.S., F.N.I., Maharashtra Association or the Cultivation of Science, Botany Laboratory, Law College Buildings, Poona 4.
- Agarwal, S. K.**, C/o. Prof. Mukut Behari Lal, Banares Hindu University, Benares.
- Agrawal, Y. K.**, Lecturer in Geology, Indian School of Mines, Dhanbad.
- ***Ahmad, Khwaja Mohammed**, Director of Archaeology, Hyderabad-Deccan.
- Ahmad, S. Shamin**, Chemistry Department, Muslim University, Aligarh.
- Aikat, B. K.**, M.D., Ph.D. (Lond.), D.C.P. (Lond.), Professor of Pathology, Medical College, Gwalior, Madhya Bharat.
- Aiya, S. V.** Chandrasekhar, M.A. (Cantab), B.Sc., A.M.I.E.E., S.M.I.R.E., Professor of Electrical Communication, College of Engineering, Poona 5.
- Aiyar, R. Gopala**, M.A., M.Sc., Professor of Zoology and Honorary Director, Madras University, Zoological Laboratory, Triplicane P.O., Madras.
- Aiyengar, N. K. N.**, M.A., B.L., F.G.S., Assistant Director, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Ajrekar, S. L.**, F.N.I., I.E.S. (retd.), 855, Shivajinagar, Bhandarkar Institute Road, P.O. Deccan Gymkhana, Poona 4.
- Alembic Chemicals Works Company Limited**, Baroda.
- Ameeta, Ram Chandra**, M.A., Professor and Head of the Department of Mathematics, Nalanda College, Biharsharif, Patna.
- Amin, D. L.**, Asst. Professor of Logic and Psychology, J. J. College of Science, Nadiad, Bombay Presidency.
- Amin, Dahyabhai S.**, 33, Alembic Colony, Baroda.
- Amin, Indubhai**, Technical Adviser, Alembic Chemicals Works Limited, Baroda.
- Amin, Manibhai Bhailalbhai**, Dipl. (Ing.) (Germany), Managing Director, The Sanitex Chemical Industries Ltd., Industrial Area, Gorwa Road, Baroda.
- Amin, Shantilal M.**, Store Controlling, 7B, Alembic Colony, Chemical Industries, Limited, P.O. Baroda.
- Amin, Vithalbhai Chhotabhai**, Research Chemist, 13, Alembic Colony, Alembic Chemical Works Co., Ltd., Baroda.
- Anand, P. L.**, Ph.D. (Lond.), Regional Director (Food), Ministry of Food and Agriculture, Office of the Regional Commissioner, 8, Esplanade East, Calcutta.
- Appajee, Y.**, B.A., M.B.B.S., M.Sc. (Lond.), Principal, Medical College, Mysore.
- Arnikar, H. J.**, M.Sc., Asst. Professor of Physical Chemistry, Chief Warden, Morvi Hostel, Banares Hindu University, Benares.
- Arora, S. D.**, M.Sc., L.T., Ph.D., Department of Chemistry, Jaswant College, Sardarpura, Jodhpur.
- Asolkar, G. V.**, M.Sc., Lecturer, College of Science, Nagpur.
- Associated Instrument Manufacturers (India), Limited**, B-5, Clive Buildings, Post Box 2136, Calcutta 1.
- Asundi, R.K.**, B.A. (Hons.), M.Sc. (Bom.), Ph.D. (Lond.), Professor of Physics, Banares Hindu University, Benares.
- Athavale, V. B.**, M.Sc., F.R.G.S. (Lond.), Professor, H. P. T. College, Nasik, Bombay Presidency.
- Atreya, B.L.**, M.A., D.Litt., University Professor and Head of the Department of Philosophy, Banaras Hindu University, Banaras.
- Auden, J. B.**, M.A., Sc.D. (Cantab), F.G.S., F.R.G.S., F.N.I., Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Aung Din, U.**, B.Sc., B.A., D.C., Forests, Silviculturist, 526, Merchant Street, Rangoon, Burma.
- Ayer, A. Ananthanarayana**, B.A., M.B.B.S., Additional Professor of Anatomy, Central Institute of Anatomy and Physiology, Medical College, Madras.

- Ayyar, K. V. Sundaran, M.Sc., F.R.I.C., 3, Jagadishwara Street, Madras 17.
 Ayyar, T. V. Ramakrishana, Rao Sahib, B.A., Ph.D., F.Z.S., 'Girija Farm', Mundur
 P.O., Via Olavakot, Malabar, South India.
 Azizuddin, I.M., B.A. G.M.V.C., Ph.D., (Edin), Principal, Madras Veterinary
 College, Madras 7.

B

- Badami, B. K., Director, Veterinary Department, H. E. H. The Nizam's Government,
 Hyderabad-Deccan.
 Badami, Rajasekhar C., Department of Chemistry, Karnatak College, Dharwar.
 Bagchi, Kanangopal, M.Sc., Lecturer in Geography, Department of Geography, Senate
 House, Calcutta.
 Bagchi, K. N., Rai Bahadur, B.Sc., M.B. (Cal.), F.I.C. (Lond.), D.T.M. (Cal. & L'pool),
 "Gulistan", 5, Ballygunge Place, Calcutta.
 Bagchee, Krishnadas, M.S., D.Sc., (Lond.), D.I.C., F.N.I., Mycologist, Forest Research
 Institute and College, New Forest, Dehra Dun.
 Bagchi, Sasanka Sekhar, 75, Bechu Chatterjee Street, Calcutta 9.
 Bagh, D., Institute of Psychology Research, Patna University, Patna.
 Bahadar, Shiva Raj, M.S., Head of the Department of Zoology, Jaswant College,
 Jodhpur.
 Bahl, K. N., D.Sc. (Panj.), D.Phill., D.Sc. (Oxon.), F.N.I., F.R.A.S.B., Professor of
 Zoology, Lucknow University, Lucknow.
 Baidya, S. P. M.S., Soil Mechanics Department, Maither, P.O. Chirkunda,
 Manbhum.
 Bal, Chandra, Major. M.Sc., Professor of Zoology, Benares Hindu University,
 Benares.
 Bal, D. V., M.Sc., Ph.D. (L'pool), F.A.Sc., Professor of Zoology, Royal Institute of
 Science, Mayo Road, Bombay 1.
 Bal, S. N., Ph.C., B.S. (Phar.), M.S., Bengal Immunity Research Institute, 39, Lower
 Circular Road, Calcutta.
 Balance Works, The, D35/68, Jangambari, Banaras 1.
 Ball, Jatindra Nath, Asst. Professor of Civil Engineering, 3, Jadavpur Central Road,
 Calcutta 22.
 Ballabh (Dr.) Ram, Reader in Mathematics, Lucknow University, Lucknow.
 Bandukwala, Kalimuddin T., L.T.C., Ph.D., Manager, Bombay Soap Factory, Ripon
 Road Cross Lane, Madanpura, Bombay 8.
 Bandyopadhyay, Gaganbehari, M.Sc., D.Phill., Professor of Mathematics, Government
 College, Darjeeling.
 Banerjee, A.C., I.E.S., (Retd.), Head of the Department of Mathematics, Allahabad
 University, Allahabad.
 Banerjee, A. N., M.Sc., Bose Research Institute, 93, Upper Circular Road, Calcutta 9.
 Banerjee, Ajit Kumar, Research Assistant (Engineering), Central Inland Fisheries
 Research Station, Government of India, Manirampur, Barrackpore.
 Banerjee, Ajit Kumar, M.A., Additional Educational Officer (R. R.), Government of
 West Bengal, Calcutta.
 Banerjee, B. N., Dept. of Bio Chemistry, Indian Institute of Science, P.O. Malles
 waram, Bangalore.
 Banerjee, Basudeb, B.Sc. (Cal.), Dr. Phil. (Munich), Sir J. C. Bose Fellow, Calcutta
 University, Bose Institute, 93, Upper Circular Road, Calcutta 9.
 Banerjee, Bhupati Kumar, M.Sc., Research Fellow of N.I.S.I., Indian Association
 for the Cultivation of Science, Jadavpur, Calcutta 32.

- Banerjee, D.**, M.Sc., Ph.D. (Lond.), A.R.I.C., F.I.R.I., General Manager and Technical Director, National Rubber Manufacturers Limited, Leslie House, 19, Chowringhee, Calcutta 13.
- Banerjee, Dr. D. P.**, Professor, Ganeshkhind, Bunglow No. 12/165, Poona 7.
- Banerjee, E. A. R.**, M.Sc., Dip. Agri., Economic Botanist to the Govt. of West Bengal, Govt. Agricultural Farm, Chinsurah, District Hooghly.
- Banerjee, H. K.**, D.Sc., Deputy Director, Central Drugs Laboratory, 121, Lower Circular Road, Calcutta 14.
- Banerjee, Hari Das**, Assistant Foreman, Calcutta Telephone Dist., Work Shop, P-29, Mission Row Extension, Flat No. 6, Calcutta.
- Banerjee, Jogesh Chandra**, M.B., M.R.C.P. (Lond.), M.R.C.S. (Eng.), Medical Practitioner, 67, Dhurrumtollah Street, Calcutta.
- Banerjee, K.**, D.Sc., F.N.I., Mahendralal Sircar Professor of Physics, Indian Association for the Cultivation of Science, Jadavpur, Calcutta 32.
- Banerjee, Kamala Nath**, B.Sc., Nadiarpara, P.O. Krishnagar, District Nadia.
- Banerjee, (Mrs.) Lila Latika**, M.A., B.T., M.A. (Columbia, U. S. A.), Principal, Victoria Institute, 78B, Upper Circular Road, Calcutta.
- Banerjee, Prosadkumar**, Statistician, Dept. of Statistics, Presidency College, Calcutta.
- Banerjee, Ramendra Nath**, M.S. (U.S.A.), B.E., E.E., A.M.I.E., Senior Professor of Engineering, Institute of Jute Technology, 35, Ballygunge Circular Road, Calcutta 19.
- Banerjee, S.**, Department of Food, Motor Transport Officer, Siliguri, West Bengal.
- Banerjee, S. L.**, D.Sc., Central Waterpower Irrigation & Research Station, Poona.
- Banerjee, Sachchidananda**, M.Sc., M.B., D.Sc. (Cal.), M.A.D.A. (U.S.A.), Senior Professor, Department of Physiology, Presidency College, Calcutta 12.
- Banerjee, Sailansu Kumar**, B.M.E., A.M.I.E., Technical Assistant to the Govt. of West Bengal, Department of Supplies, 22, Panchanantolla Road, Howrah.
- Banerjee, Dr. Samiran**, 9-2B, Palit Street, Calcutta 19.
- Banerjee, S. N.**, M.Sc., Ph.D. (Lond.), C.M.Z.S., (Lond.), F.R.E.S. (Lond.), Entomologist, Government of West Bengal, State Agriculture Farm, Chinsurah, Hooghly.
- Banerjee, S. S.**, D.Sc., F.I.P.S., M.I.R.E., Professor of Engineering College, Benares Hindu University, Benares.
- Banerjee, Subhamoy**, Ph.D. (Sheffield), A.M., Inst.F. (Lond.), Lecturer in Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Banerjee, Suresh Chandra**, B.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Banerjee, T.**, Ph.D. (Lond.), D.Sc., F.R.I.C., Asst. Director, National Metallurgical Laboratory, P.O. Burma Mines, Jamshedpur.
- Banerji, Arya Kumar**, M.Sc., Professor of Biology, Scottish Churches College, 62, Beltala Road, Calcutta 25.
- Banerji, I.**, M.Sc., D.Sc., F.N.I., F.L.S., F.A.Sc., University Lecturer in Botany, 131, Harish Mukherjee Road, Kalighat, Calcutta.
- Banerji, Nabajiban**, M.B., Director, Calcutta Clinical Research Association, 10, Rowdon Street, Calcutta.
- Banerji, Dr. S. M.**, M.Sc., M.B., Professor of Physiology, Orissa Medical College, Cuttack.
- Banerji, Satyabrata**, B.E., D.I.I.Sc., A.M.I.E., A.I.R.E., Asst. Engineer, All-India Radio, 35, Paikpara Road, Calcutta 2.
- Banerji, Sudhansu Kumar**, O.B.E., D.Sc., F.N.I., 3, Ramani Chatterjee Road, P.O. R. B. Avenue, Calcutta.
- Banerji, Choudhury, Pabitra Kanta**, Asst. Engineer, Calcutta Corporation (District No. 1), 15, Ramchand Nandi Lane, Calcutta 6.

- Bapat**, B. V., Principal, Tilak College of Education, Tilak Road, Poona 5.
- Barai**, S. C., Asst. Research Officer, Central Waterpower Irrigation & Navigation Research Station, Poona.
- Barat**, C., M.Sc., Dr. Ing., A.R.I.C., Technical Director, Calcutta Industrial Chemicals and Minerals Co., Ltd., 4, Earle Street, P.O. Kalighat, Calcutta 26.
- Barave**, Raghunath Vinayak, M.Sc., Professor of Physics, Willingdon College, District Satara, Bombay.
- Bardhan**, Lieut. Col. P. N., I.A.M.C., L.M.S. (Singapur), F.R.C.P. (Edin.), D.P.H. (Eng.), M.M.S.A., D.R.C.O.G., Officer-in-Charge, Pathology Department, Armed Forces Medical College, Poona.
- Baria**, (Mrs.) D. D. H., M.Sc., "Panorama", 203, Walkshwar Road, Malabar Hill, Bombay 6.
- Barooah**, Satya Ranjan, M.Sc., F.B.S., Ph.D., Additional Director of Agriculture, Shillong.
- Brave**, Prof. P. M., M.Sc., Department of Chemistry, Wilson College, Bombay 7.
- Basak**, K. C., B.A., Director of Economic Research, Indian Central Jute Committee, 4, Hastings Street, Calcutta.
- Basak**, Manindra Nath, M.B., D.T.M., Medical Practitioner, 15, Anukul Mukherji Road, Calcutta.
- Basu**, Ajit Kumar, Director, M/S. Bien Artium Natural Sciences Ltd., 6, Mangoe Lane, Calcutta.
- Basu**, Amal Chandra, M.A., Addl. Entomologist to West Bengal, 25, S. R. Das Road, Calcutta 26.
- Basu**, Amiya Kumar, Professor, Department of Mechanical Engineering, College of Engineering & Technology, Jadavpur, Calcutta 32.
- Basu**, Prof. A. K., M.Sc., C/o. Biological Supply Concern, 5-A, Kali Datta Street, Calcutta 5.
- *Basu**, Anath Nath M.A. (Lond.), T.D. (Lond.), Principal, Central Institute of Education, Probyn Road, Delhi 2.
- Basu**, B. C., D.Sc., Entomologist, Indian Veterinary Research Institute, P.O. Izatnagar, Bareilly.
- Basu**, B. N., Professor of Anatomy, R. G. Kar Medical College, 44-1, Ramdhone Mitter Lane, Shambazar, Calcutta.
- Basu**, Charu Chandra, B.A., M.B., Medical Practitioner, Professor of Pathology, R. G. Kar Medical College, Calcutta.
- Basu**, Debabrata, Research Scholar, Indian Statistical Institute, Presidency College, Calcutta.
- Basu**, Dulal Chandra, B.E.E., Engineer, Government Telegraph Work-shop Alipore, 20, Iswar Mill Lane, Calcutta 6.
- Basu**, J. K., M.Sc. (Cal.), Ph.D. (Lond.), F.N.I., Soil Physicist to Government, B. P. Central Building, Poona 1.
- Basu**, J. N., M.I.E., M.A.E., V.D.I., Dr. Eng., Professor of Mechanical Engineering, College of Engineering and Technology, P.O. Jadavpur College, 24-Parganas.
- Basu**, K. P., D.Sc., Ph.D., Dairy Chemist, Indian Dairy Research Institute, Bangalore.
- Basu**, Minendra Nath, M.Sc., P.R.S., D.Phil., F.R.A.I. (Lond.), Lecturer in Anthropology, University College of Science, Supdt. Post Graduate Science Mess, 35, Ballygunge Circular Road, Calcutta.
- Basu**, M. R., Department of Chemistry, Indian School of Mines & Applied Geology, Dhanbad.
- Basu**, Nani Gopal M.Sc., M.B., Lecturer in Zoology, Vidyasagar College, 16, Abhay Sarkar Lane, Calcutta, 20.
- Basu**, N. K., Department of Pharmaceutics, Benares Hindu University, Benares.
- Basu**, Prof. N. K., Professor of Mathematics, Muslim University, Aligarh.

- Basu, Narendra Mohan**, M.A., F.N.I., 63, Hindusthan Park, Ballygunge, Calcutta 29.
- Basu, (Capt.) R. N.**, M.Sc., M.B.B.S., A.I.R.O., Lecturer in Anthropology, Calcutta University, 7A, Nafar Kundu Road, Calcutta 26.
- *Basu, S.**, M.Sc., F.N.I., Deputy Director General of Observatories, Meteorological Office, Ganesh Khind Road, Poona 5.
- Basu, Sarojaksha**, B.Sc., Engg. (Glass), C.P.E. (Glass), M.A.E., A.M.I.E., etc. Naval Architect. Superintendent Boat Registration, The Commissioners for the Port of Calcutta, 143, Dharamtollah Street, Calcutta 13.
- Basu, S. K.**, M.A., Ph.D. (Lond.), Professor of Pure Mathematics, Presidency College, Calcutta; 90, Jatin Das Road, Calcutta 29.
- Basu, Sushil Kumar**, M.Sc., M.B., D.T.M., D.P.H., Ph.D. (Edin.), Professor of Anatomy, Nil Ratan Sarkar Medical College, Calcutta; 39, Narkeldanga Main Road, Calcutta 11.
- Basu, Saradindu Ranjan**, M.Sc., Vice-Principal, Teachers' Training College, Corporation of Calcutta, 5-B, Jugannath Sur Lane, Calcutta 6.
- Basu, Satyendra Prasanna**, M.Sc., B.F.S., Supdt. of Fisheries, Govt. of West Bengal and Research Fellow, 44, Girish Mukherjee Road, Bhowanipur, Calcutta.
- *Basu, U. P.**, D.Sc., P.R.S., F.N.I., 98-4, Surendra Nath Banerjee Road, Calcutta 14.
- Bavdekar, P. R.**, M.Sc., Ph.D. (Bomb.), Research Chemist, Tata Chemicals Limited, Mithapur, Okhamandal, Kathiawad.
- Baweja, K. D.**, Rai Bahadur, M.Sc., Ph.D. (Lond.), Professor of Entomology, Hindu University, Banaras.
- Baweja, (R. B.) K. D.**, M.Sc. (Ph.), Ph.D. (Lond.), Entomologist to the Government of Rajasthan, Jaipur (Rajasthan).
- Begg, M. M.**, University Teacher, Principal, Delhi College, Delhi.
- Behari, Ram**, M.A. (Panj.) (App. Math.), M.A. (Pure Maths.), M.A. (Cantab), Ph.D., ScD. (Dublin), F.N.I., Head of the Department of Mathematics, Delhi University, St. Stephen's College, Delhi.
- Behura, B. K.**, M.Sc., Ph.D. (Edin.), F.R.E.S. (Lond.), Dept of Zoology, Ravenshaw College, Cuttack, Orissa.
- Belavadi, (Miss) Bhavani**, B.Sc. (Hons.), M. G. Chitnavis Research Fellow, University Department of Biochemistry, Nagpur.
- Benwari, N. P.**, M.D. (Hons.), Professor of Physiology, G. R. Medical College, Gwalior.
- Bera, Gajendra Narayan**, Lecturer in Physiology, Presidency College, Calcutta.
- Bhabha, H. J.**, D.Sc., F.R.S., Director, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay 1.
- *Bhabe, V. M.**, M.Sc., Ph.D., A.R.I.E., Professor of Chemistry, Ramnarain Ruia College, Matunga, Bombay 19.
- Bhaduri, Baidya Nath**, M.B., Visiting Ophthalmic Surgeon, R. G. Kar Medical College Hospital, Calcutta.
- Bhaduri, Dr. J. L.**, D.Sc., F.N.I., Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Bhaduri, Manindra Bhusan**, B.A., B.L., P.O. Khunti, District Ranchi.
- Bhaduri, N. V.**, M.Sc., M.B., Office-in-Charge, Filariasis Research Dept & Hilminthology Research Department, School of Tropical Medicine, Calcutta.
- †Bhaduri, P. N.**, M.Sc., Ph.D., F.N.I., F.L.S., Cylogenellash Botany Division, Agricultural Research Institute, New Delhi.
- Bhagat, M. G.**, M.A., B.Sc., Ceramic Engineer, 45, Tangra Road, Calcutta.
- Bhagavantam, S.**, Department of Physics, Osmania University, Hyderabad-Deccan.
- Bhagwat, W. V.**, D.Sc., F.A.Sc., Head of the Chemistry Department, Holkar College, Indore.
- Bhandari, Narendra Nath**, B.A., D.I.C., Ph.D. (Lond.), Assistant Secretary, Central Board of Irrigation, Kennedy House, Simla, S. W.

- Bhardwaj, D. C.**, M.Sc., Institute of Palaeobotany, Dept. of Botany, The University, Lucknow.
- Bhardwaja, Y.**, M.Sc. (Panj.), Ph.D. (Lond.), F.L.S. (Lond.), F.N.I., Head of the Department of Botany, Benares Hindu University, Benares.
- Bhargava, P. M.**, M.Sc., Ph.D., C/o. Dr. R. C. Bhargava, Municipal Medical Officer of Health, Japan House, Marris Road, Aligarh, U. P.
- Bhaskaran, T. R.**, D.Sc., S.M., A.I.I.E., Asst. Professor of Sanitary Engineering, All-India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Bhat, J. V.**, Head of the Microbiology Department, St. Xaivers College, Cruickshank Road, Bombay 1.
- Bhatia, M. L.**, M.Sc., Ph.D., D.Sc., Head of the Dept. of Zoology, University of Delhi, Delhi.
- Bhatnagar, P. S.**, M.Sc., Tech., Asst. Professor of Applied Chemistry, Engineering College, Benares Hindu University, Benares.
- Bhatnagar, S. S.**, Col., Ph.D., M.D., Director, Caius Research Laboratory, St. Xaviers College, 14, Zainab Manzil, Church Gate Reclamation, Bombay 1.
- Bhatnagar, Sir Shanti Swarup**, Kt. O.B.E., D.Sc., F.R.S., F.I.C., F.S.C.I. (Hons.), F.N.I., Secretary to the Government of India, Ministry of Natural Resources and Scientific Research, New Delhi.
- Bhatt, L. A.**, M.Sc., Ph.D. (Lond.), Kalichand Devchand & Co., Ltd., 45-47, Applo Street, Fort, Bombay.
- Bhatt, L.J.**, M.A., B.T., Juna Modikhana, Baroda.
- Bhatt, N. B.**, D.Sc., F.Inst., P.S.M.I.R.E., A.M.I.E.E., Mem., A.S.A., Defence Science Organisation, National Physical Lab., Pusa Road, New Delhi.
- Bhatt, N. M.**, M.Sc., Ph.D. (Edin.), F.S.S. (Lond.), Behind Raopura Tower, Baroda.
- Bhattacharya, Dr. A. K.**, Department of Chemistry, University of Saugor, Saugor.
- Bhattacharya, A. P.**, Statistical Office, Irrigation Research Division, Roorkee, U.P.
- Bhattacharya, Anil**, M.A., Head of the Department of Statistics, Presidency College, Calcutta.
- Bhattacharya, Ardhendu Sekhar**, M.Sc., Sri Arabinda Asram, Pondicherry.
- Bhattacharya, B.**, Lt.-Col., M.B.B.S., M.R.C.S., M.R.C.P., D.P.M., Military Hospital, Aundh Camp, Poona.
- Bhattacharya, B. C.**, M.Sc., Tech. (Manch.), B.Sc. (Cal.), A.M.C.T., F.T.I., Principal, Bengal Textile Institute, Serampore (E. I. Rly.).
- * Bhattacharya, Biswa Nath**, M.Sc., C/o. S. N. Bhattacharya, 10, Bhattacharjee Lane, Serampore, West Bengal.
- Bhattacharya, D. R.**, M.Sc., Ph.D. (Dublin), Docteur-es-Sciences (Paris), F.N.I., 7, Malvya Road, George Town, Allahabad.
- Bhattacharya, G.**, M.Sc., Mg. Director, M/s. Adair Dutt & Co., Ltd., 5, Dalhousie Square East, Calcutta.
- Bhattacharya, Dr. Jayanta Kumar**, B.Sc., M.B., D.P.H. (Cal.), M.P.H. (Johns Hopkins), Singur Health Centre, P.O. Singur, Hooghly, West Bengal.
- Bhattacharya, N. C.**, C/o. Mr. B. K. Sarkar, 14-2, Bhabha Nath Sen Street, Calcutta.
- Bhattacharya, Punyabrata**, M.Sc., Ph.D., Officer-in-Charge, Animal Genetics Section, Indian Veterinary Research Institute, Izatnagar (U.P.).
- Bhattacharya, Rabindra Nath**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Bhattacharya, S. C.**, M.Sc., Dept. of Psychology, 5-1, Suri Lane, Calcutta 14.
- Bhattacharya, Sukhamoy**, B.Sc. (Hons.), A.R.I.C., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Bhattacharya, Syama Sankar**, Lecturer in Botany, Presidency College, 56, Hazrapara Lane, Bally, Howrah.

- Bhattacharyya**, Amulya Chandra, Assistant Engineer, Calcutta Corporation, 1B, Iswar Choudhury Road, Ballygunge, Calcutta 29.
- Bhattacharyya**, Asutosh, M.A., Research Associate, Department of Anthropology, Indian Museum, Calcutta 13.
- Bhattacharyya**, Dr. S. C., Central Drugs Laboratory, 110, Chittaranjan Avenue, Calcutta; Lower Circular Road, Calcutta 16.
- Bhattacharyya**, Shyamadas, M.Sc., Chemist, Calcutta Industrial Chemical & Mineral Co., Ltd., 1-1-D, Ananda Chatterjee Lane, Calcutta 3.
- Bhattacharyya**, Sushil Kumar, B.E.E., A.M.I.E., M.Amer., I.E.E., Electrical Engineer-in-Charge, P. & T. Workshop, Alipore, Calcutta 27.
- Bhaumik**, H. P., O.B.E., M.I.E. (Ind.), 21-1, Mandeville Gardens, Ballygunge, Calcutta.
- Bhende**, V. R., Secretary, Bombay Presidency Association, 107, Esplanade Road, Fort, Bombay.
- Bhide**, B. V., M.Sc., A.I.I.Sc., S. P. College, Poona 2.
- Bhide**, V. G., Dept. of Physics, College of Science, Nagpur 1.
- Bhowmik**, B., Lecturer Department of Physics, University of Delhi, Delhi.
- Bhowmik**, B. B., M.Sc., 7, Sirdar Sankar Road, Kalighat, Calcutta 26.
- Bhowmik**, Nikhil Ranjan, Engineer, United Commercial Service Ltd., P-39, Princep Street, Calcutta.
- Bhowmik**, Santimoy, B.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Bhusan**, Bharat, M.Sc., Central Laboratories for Scientific & Industrial Research, Hyderabad-Deccan.
- Bhushan**, V. N., Principal, M. M. Arts. College and N. M. Institute of Science, Andheri, Bombay 12.
- Bhusry**, P. N., Electrical Engineer, G. E. C. (India) Ltd., Magnet House, Chittaranjan Avenue, Calcutta.
- Bidvai**, Bhalechandra K., Chaporkar Pleader's House, Station Road, Amaravati, Berar.
- Bien Artium** Natural Sciences Limited, 6, Mango Lane, Calcutta.
- Binani**, G. D., 38, Strand Road, Calcutta.
- Biswas**, Anil Bhusan, M.Sc., Ph.D., Lecturer, Department of Chemistry, University of Delhi, Delhi 8.
- Biswas**, Buddhadeb, M.Sc., Laboratory Geologist, Strand Vacuum Oil Co., Limited, 16/14, Belegkata Main Road, Calcutta 10.
- Biswas**, Dr. Harāgopal, Research Chemist, B. C. P. W. Ltd., 164, Maniktala Main Road, Calcutta.
- Biswas**, K., M.A., D.Sc. (Edin), F.R.S.E., F.N.I., Superintendent, Indian Botanic Garden, Calcutta.
- Biswas**, Mohini Mohan, Research Chemist, Bengal Chemical & Pharmaceutical Works Ltd., 164, Maniktala Main Road, Calcutta.
- Biswas**, P. C., M.Sc., Ph.D. (Berlin), Reader in Anthropology, Delhi University, Delhi.
- Biswas**, P. C., Professor of Physics, Jadavpur College, 27, Sasi Bhusan Ray Street, Calcutta 12.
- Bose**, A. C., B.Sc. (Mich. U.S.A.), M.M.G., 3, Alipore Avenue, Calcutta 27.
- Bose**, A. K., M.Sc., M.B., M.R.C.S. (Eng.), M.R.C.P. (Lond.), Cardiologist, Calcutta General Hospital, 63, Elliot Road, Calcutta.
- Bose**, A. N., M.B., Pharmacologist, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Bose**, A. N., M.Sc., Ph.D., Lecturer in Chemistry, Chemistry Department, Lucknow University Lucknow.
- Bose**, A. N., Dr. Ing., A.R.I.C., 1, Woodburn Park Calcutta 20.

- Bose, Adhir Kumar**, A.M.I.E., Proprietor, Krishna Engineering Co., P-39, Princep Street, Calcutta 13.
- Bose, Akshoy Kumar**, B.E.C.E., M.I.E., Partner M/S. Ballardii Thompson Mathas, Engineers & Architects, 7, Wellesly Place, Calcutta.
- Bose, Amullya Kanto**, A.M.A.E., Civil Engineer, A. C. C. Ltd., Kymore Cement Works, Kymore P.O., Via—Jukehi, G. I. P., Madhya Pradesh.
- Bose, Dr. Arabinda Nath**, Ph.D., (M.I.T.), Prof. of Food Technology, College of Engineering and Technology, Jadavpur, Calcutta 32.
- Bose, (Mrs.) Atasi**, M.Sc., C/o. Dr. Utsab Kumar Bose, Meteorological Office, Quarter No. 310/12, Aerodrome, Dum Dum.
- Bose, B. C.**, M.D., D.Sc., D.T.M., Principal, Mahatma Gandhi Memorial Medical College, Indore, C. I.
- Bose, Benoy Kumar**, M.Sc., D.I.C., A.Inst.M.M., Chief Assayer, India Government Mint, Bombay 1.
- Bose, (Mrs.) Chameli**, B.Sc. (Lond.), Statistician, Statistical Laboratory, Presidency College, Calcutta.
- Bose, Dr. D.M.**, Director, Bose Institute, 93, Upper Circular Road, Calcutta.
- Bose, H.**, C/o. Mr. B. K. Sarkar, 14-2, Bhaba Nath Sen Street, Calcutta.
- Bose, H. K.**, Department of Anthropology, Indian Museum, Calcutta.
- Bose, Dr. J. K.**, M.A., B.L., P.R.S., Ph.D. (Lond.), F.R.A.I., Labour Adviser, Indian Engineering Association, Bengal Chamber of Commerce, Calcutta.
- Bose, K. M.**, C/o. Mr. B. K. Sarkar, 14-2, Bhaba Nath Sen Street, Calcutta.
- Bose, Kalyan Kumar**, A.M.I.E., Dipl. Ing. (Munich), Dr. Ing. (Dresden), Senior Scientist, Ministry of Defence Science Laboratory, Pusa, Delhi 5.
- Bose, M. K.**, M.Sc., Superintendent, Assay Office, I. G. Mint, Bombay 1.
- Bose, Mahendra Nath**, Birbal Salim Institute of Palaeobotany, Lucknow.
- Bose, Nirmal Kumar**, M.Sc., Lecturer in Geography, 37, Bosepara Lane, Calcutta 3.
- Bose, Navin Chandra**, M.Sc., Research Scholar, Dept. of Geography, University of Calcutta, Calcutta.
- Bose, P. C.**, C/o. Mr. B. K. Sarkar, 14-2, Bhaba Nath Sen Street, Calcutta.
- Bose, P. C.**, 25, Culbon Road, Bangalore 2.
- Bose, P. K.**, D.Sc., Director, Indian Lac Research Institute, Namkum P.O., Ranchi.
- Bose, Purnendu Kumar**, M.Sc., D.Phil., Lecturer, Department of Statistics, Calcutta University, Asutosh Building, Calcutta.
- Bose, S.**, M.Sc., Ph.D. (Lond.), Poultry Research Section, Indian Veterinary Research Institute, Izatnagar.
- Bose, S. K.**, A.R.S.M., B.Sc. (Lond.), Professor of Mining & Surveying, Indian School of Mines, Dhanbad.
- Bose, Satyendra Nath**, M.Sc., F.N.I., Khaira, Professor of Physics, University College of Science, 92, Upper Circular Road, Calcutta.
- Bose, S. K.**, B.Sc., M.Inst.F., F.G.M.S., Fuel Economic Section, Coal Commissioner's Office, 1, Council House Street, Calcutta.
- Bose, S. R.**, Ph.D., F.R.S.E., F.L.S., F.N.I., Professor of Botany, R. G. Kar Medical College, 1, Belgatchia Road, Calcutta.
- Bose, Souren**, Managing Director, Power Machinery (India) Ltd., 3, Mango Lane, Calcutta 1.
- Bose, Sripati**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Bose, Subodh Chandra**, M.A., Professor of Geography, Asutosh College, Calcutta.
- Bose, Sudhir Kumar**, M.Sc., M.A., In-charge, Applied Psychology, University College of Science, 92, Upper Circular Road, Calcutta.
- Bose, Suresh Chandra**, A.M.A.E., Sanitary & Structural Engineer, 293, Bowbazar Street, Calcutta.

- Bose, (Dr.) Susanta Kumar**, 29, Circular Road, Ranchi.
- Bose, Susil Kumar**, M.Sc., D.Phil., Department of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Bose, (Sm.) U.**, M.Sc., Assistant Anthropologist, Dept. of Anthropology, Government of India, Indian Museum, Calcutta 13.
- Bose, Utsab Kumar**, M.Sc., Ph.D., Meteorological Office, Calcutta Air Port, Aerodrome Dum Dum.
- Bose Majumder, Nirmal Kumar**, Professor of Mathematics, St. Xaviers College, 69, Babu Ram Ghosh Road, Tollygunge, Calcutta.
- Brahmachari, Nirmal Kumar**, M.Sc., 19, Loudon Street, Calcutta.
- Brahmachari, Phanindranath**, M.Sc., M.B., M.D., 19, Loudon Street, Calcutta.
- Burma, Debi Prosad**, M.Sc., Research Scholar, Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Burman, U. R.**, M.Sc., Lecturer in Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.

C

- Cadambe, V.**, Assistant Director, The National Physical Laboratory, Divn. of Applied Mechanics, Hill Side Road, New Delhi 12.
- Calcutta Industrial Chemicals & Minerals Co., Ltd.**, 43, Dharamtala Street, Calcutta.
- Captain, K. S.**, M.B.B.S., D.T.M., & H.L.N., M. O. Vani Vilas Hospital, 1, Cenotaph Road, Bangalore City.
- Cassad, D. P. R.**, M.Sc. (Eng.) (Lond.), B.Sc., M.M.G.I., M.R.San.I. (Lond.), etc., Chartered Engineer, Managing Director, C. P. Syndicate Ltd., Dolly Dale Byramji Tower, Nagpur, M. P.
- Caws, A.**, Begg, Sutherland & Co., Ltd., Marhowrah, Saran District, Bihar.
- Central Waterways Irrigation & Navigation Research Station**, Poona.
- Chacka, P. I.**, M.A., F.Z.S., Asst. Director of Fisheries (Freshwater Biology), Fresh Water Biological Research Station, 95, Poona Mallie High Road, Kilpauk, Madras.
- Chaki, M. C.**, M.A., Professor of Mathematics, Bangabasi College, Scott Lane, Calcutta.
- Chakko, K. C.**, B.A., D.Sc. (Lond.), M.I.E. (Ind.), 5, Grant Road, Bangalore.
- Chakrabarti, Bijoy Kumar**, M.Sc., M.B., Lecturer, Medical College, Dr. Ramlal Chakrabarty Road, Lucknow.
- Chakrabarti, J. N.**, Lecturer in Chemistry, Indian School of Mines & Applied Geology, Dhanbad.
- Chakrabarti, Nani Gopal**, A.M.I.P.E., M.I.B.F., M.M.G.I., M.A.E., Works Manager, Bhartia Electric Steel Co., Ltd., 8, Swinhoe Street, Calcutta 19.
- Chakrabarty, S. K.**, D.Sc., F.N.I., Bengal Engineering College, Sibpore, Howrah.
- Chakrabarty, Monmatha Nath**, Professor of Electrical Engineering, College of Engineering & Technology, Jadavpur, Calcutta 32.
- Chakrabarti, S. C.**, M.Sc., Ex-Professor of Mathematics, Jadavpur College, Banerjee para, Dhakuria P.O., 24-Parganas.
- Chakraborti, Mohini Mohan**, B.E.E., A.M.E.E., A.M.I.E., Asst. Electrical Engineer, C.P.W.D., 30B, Garcha 1st Lane, Calcutta 19.
- Chakraborty, Dharendra Mohan**, 1, Barik Lane, Calcutta 6.
- Chakraborty, J. N.**, M.Sc., Ph.D., Assoc. I.A.R.I., Soil Scientist, Damodar Valley Corporation, Hazaribagh.
- Chakraborty, Ramesh Chandra**, M.B., Registrar, Surgical Department, R. G. Kar Medical College, Calcutta.

- Chakraborti**, Saroj Kumar, M.Sc., Asst. Manager (Apparatus). Bengal Chemical and Pharmaceutical Works, Ltd., 161, Manicktollah Main Road, Calcutta.
- Chakrabortty**, Shib Charan, Asst. Professor of Public Health Chemistry, All India Institute of Hygiene & Public Healths, 110, Chittaranjan Avenue, Calcutta.
- Chakravarti**, Amulyaratan, B.Sc., M.B. (Cal.), F.R.C.P., F.R.S. Edin., Consulting Physician & Biochemist, 1, Furripooker Street, Calcutta.
- Chakravarti**, B. C., M.Sc., M.M.G.I., F.G.M.S., Mining Geologist, C/o. Natural Science (India) Ltd., 37, Grosvenor House, 21, Old Court House Street, Calcutta 1.
- Chakravarti**, D. K., B.E., A.M.I.E. (Ind.), Chartered Engineer, 10, Convent Road, Calcutta.
- Chakravarti** Dharendra Kishore, M.Sc., F.G.M.S., Prof. of Petrology, Dept. of Geology, Banaras Hindu University, Banaras.
- Chakravarti**, Dukhaharan, D.Sc., Lecturer in Chemistry, University College of Science, Secty. Post Graduate, Dept. of Teaching in Science, 28/3, Sahaganagar Road, Kalighat, Calcutta.
- Chakravarti**, G. K., M.Sc., Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Chakravarti**, Jiban Kumar, M.Sc., Research Scholar, Chemical Laboratory, Presidency College, Calcutta.
- Chakravarti**, Khagendra Mohon, Electrical Engineer, William Jacks & Co., Ltd., 17A, South End Park, Calcutta 29.
- Chakravarti**, Khagendra Nath, M.Sc., 15D, Ekdalia Place, Ballygunge, Calcutta.
- Chakravarti**, M. L., M.Sc., M.B., Ph.D. (Lond.), Prof. of Physiology, Medical College, Calcutta.
- Chakravarti**, M. M., M.Sc., Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Chakravarti**, N., B.Sc. (Cal.), M.A. (Cantab), A.M.I.E. (Ind.), Director, Provincial Statistical Bureau, West Bengal, Writers' Buildings, Calcutta.
- Chakravarti**, N. G., M.Sc., Professor of Chemistry, Presidency College, Calcutta 12.
- Chakravarti**, Nirmal Kumar, M.Sc., 22, Goabagan Lane, Calcutta 6.
- Chakravarti**, N. P., Ph.D., Joint Director-General of Archaeology in India, Curzon Road Barracks, New Delhi.
- ***Chakravarti**, R. N., D.Sc., F.R.I.C., Prof. of Chemistry, School of Tropical Medicine, Chittaranjan Avenue, Calcutta 12.
- Chakravarti**, S. C., Director, The Balance Works Ltd., D35/68, Jangambari, Benaras.
- Chakravarti**, S. C., Associate Professor of Botany, B. R. College, Agra.
- Chakravarti**, S. P., M.S. (Eng.) (Lond.), D.I.C., M.I.E.E., Principal, Government Engineering College, P.O. Gokulpore, Jubbulpore.
- Chakravarti**, Surapati, B.Sc., M.A., Technical Expert, National Chemical & Salt Works, 5, Commercial Buildings, Clive Streets, Calcutta.
- Chakravarty**, G., B.E., M.E.I.O.S., Assistant Superintendent of Development, T. D. E. (Weapons), Ishapore.
- Chakravarty**, H. L., D.Sc. (Edin.), M.A. (Cantab), F.L.S., F.R.A.S.B., Professor and Head of the Department of Botany, Presidency College, Calcutta.
- Chakravarty**, Hareram, Chemist, Calcutta Industrial Chemical & Mineral Co., Ltd., 20A, Kali Prosad Chakravarti Street, Calcutta 3.
- Chakravortti**, S., S.R.C.P. (Lond.), M.R.C.P. (Eng.), Staff Medical Officer, Imperial Chemical Industries (India) Ltd., 18, Strand Road, Calcutta 1.
- Chanchani**, Anritlal J., Colliery Proprietor and Contractor, 137, Canning Street, Calcutta.

- Chandra, R.**, M.A., B.Sc. (Agri.), Asst. Director of Inspection (Class I), Ministry of Food and Agriculture, Govt. of India, Jamnagar House, Mansingh Road, New Delhi. 9
- Chandra, Umesh**, M.Sc., Lecturer in Geology, Ranchi College, Ranchi.
- Chandrasekharan, K.**, M.A., M.Sc., Ph.D., Reader in Mathematics, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay.
- Chanmugam, W. R.**, F.R.I.C., D.I.C., Government Analyst, Government Analyst's Laboratory, Colombo 7, Ceylon.
- Chatterjee, A.**, M.B.B.S., Hony. Secretary, Students' Welfare Committee and Lecturer in Anthropology, University of Calcutta, 28, Indra Roy Road, Calcutta.
- Chatterjee, Aniya Bhusan**, M.Sc., Lecturer in Geography, Presidency College, Calcutta 7.
- Chatterjee, Aniya Nath**, B.E.E., A.M.I.E., M.A.E., M.Merh.E.A., M.I.S.E., etc., Chief Engineer, M/s. Motor & Machinery Manufacturers Ltd., 10, Jawpur Road, South Dum Dum, Calcutta 30.
- Chatterjee, Mrs. Asima**, D.Sc., Professor of Chemistry, Lady Brabourne College and Lecturer in Chemistry, Calcutta University College of Science, 92, Upper Circular Road, Calcutta.
- Chatterjee, Bankim Chandra**, M.Sc., Lecturer Pure Mathematics, Calcutta University, Masterpara, Konnagar P.O., Hooghly.
- Chatterjee, B. K.**, D.Sc. (Paris), Anthoropologist, Department of Anthoropology, Indian Museum, Calcutta.
- Chatterjee, Baradanath**, Asst. Professor of Chemistry, Department of Chemistry and Metallurgy, Bengal Engineering College, Howrah.
- Chatterjee, Bimal Kumar**, M.Sc., Prof. of Biology, Govt. College, Darjeeling.
- Chatterjee, Chittaranjan**, City Division, Transport Officer, West Bengal Government, Kidderpore, Calcutta.
- Chatterjee, D.**, M.Sc., Ph.D., F.C.S., Systemic Botanist, Botany Division, Agricultural Research Institute, New Delhi 12.
- Chatterjee, G. P.**, Ph.D. (Metallurgical Engineering), Ph.D. (Physics), M.I.I.N., Asst. Prof. of Metallurgy, Bengal Engineering College, Howrah.
- Chatterjee, Indubhusan**, M.Sc. (Agri.), L.Ag., 119B, Shyambazar Street, Calcutta.
- Chatterjee, K. C.**, C/o. Boots Pure Drug Co. (India) Ltd., Sion Works, Bombay 22.
- Chatterjee, Krishnadhan**, M.D. (Cal.), 6, Amrita Bannerjee Road, Kalighat, Calcutta.
- Chatterjee, Kesab Lal**, 34/3, Shankar Halder Lane, Calcutta.
- ***Chatterjee, M. L.**, M.B., Pharmacologist, Bengal Drug Control Unit, Department of Pharmacology, School of Tropical Medicine, Chittaranjan Avenue, Cal.
- Chatterjee, N. N.**, D.Sc., Deputy Controller of Patents, Government of India, 211, Lower Circular Road, Calcutta 17.
- Chatterjee, Nirmal Nath**, M.Sc., Lecturer in Geology, Calcutta University, Presidency College, 73A, Harish Mukherjee Road, Calcutta.
- Chatterjee, Prakriti Bhusan**, B.M.E., Lecturer, College of Engineering & Technology Jadavpur, Jhill Road, Jadavpur, Calcutta 32.
- Chatterjee, P. K.**, M.Sc., P.R.S., Geologist, Geological Survey of India, 27, Chowringee, Calcutta 13.
- Chatterjee, P. K.**, Indian Statistical Laboratory, Presidency College, Calcutta.
- Chatterjee, (Dr.) S. C.**, Training College, Berhampore, West Bengal.
- Chatterjee, Sajani Kumar**, M.B., D.P.H. (Cal.), D.T.M., (L'pool), Officer-in-Charge, Provincial Public Health Laboratory, Bankipore, P.O. Patna.
- Chatterjee, Sati Nath**, B.Com., A.C.A., Chartered Accountant, 190, Lansdowne Rd., Calcutta.
- Chatterjee, S. N.**, Proprietor, M/S. Dominion Rubber Co., 52-1, Hazra Road, Cal. 19.

- Chatterjee, S. P.**, M.Sc., Ph.D., (Lond.), D.Litt. (Paris), Head of the Department of Geography, Calcutta University, Senate House, Calcutta.
- Chatterjee, Satya Narayan**, B.Sc., B.Sc.Engg, Asst. Engineer, Telephones, 16A, Bepin Pal Road, Calcutta 26.
- Chatterjee, Satya Charan**, D.Sc., P.R.S., F.N.I., F.G.M.S., Professor of Geography, Patna College, Bankipur, Patna.
- Chatterjee, Somen**, B.E.E., A.M.A.E., Electrical Engineer, 13, Puddopukur Lane, Calcutta 20.
- Chatterjee, Udayan**, Department of Applied Chemistry, University College of Science, & Technology, 92, Upper Circular Road, Calcutta 9.
- Chatterji, A. C.** D.Sc., Dr. Ing., Prof. and the Head of the Chemistry Dept. and Public Analyst to the U. P. Govt., Lucknow University, Lucknow.
- Chatterjee, Banbihari**, M.Sc., M.B., Medical Practitioner and Lecturer in Physiology Calcutta University, 82, Dr. Suresh Sarkar Bye Lane, Entally, Calcutta.
- Chatterji, (Mrs.) Bani**, D. Mas., Sangeeta-Varati, C/o Dr. S. K. Chatterji, M.B., D.T.M., Ph.D., Chemical Department, Medical College, Calcutta.
- Chatterji, (Miss) Gitanjali**, C/o Dr. S.K. Chatterjee, M.B., D.T.M., Ph. D., Chemical Department, Medical College, Calcutta.
- Chatterjee, N.N.**, M.B.B.S., M.Sc., Lumbini Park Mental Hospital, 124, Badiadanga Road, Tiljala P.O., Calcutta.
- Chatterjee, S. K.** M.B., D.T.M. (Cal.), Ph.D. (Edin), Chemical Examiner to the Government of West Bengal, Medical College, Calcutta.
- Chatterjee, S. N.**, Electrical Engineer, C/o B. I. Callenders' Cables Ltd., 9, Hare Street, Calcutta.
- Chatterji, Satyabrata**, A.M.M.E., Assistant Director of Supplies, Ministry of Industries & Supply, Government of India, 8, Ramnidhi Chatterjee Lane, Uttarpara, Dt. Hooghly.
- Chattopadhyay, Haripada**, M.Sc., Dept. of Physiology, Presidency College, Cal.
- Chattopadhyay, K. P.**, M.Sc., (Cantab), Professor of Anthropology, Calcutta University, 2, Palm Place, Ballygunge, Calcutta.
- Chattopadhyay, S. B.**, D.Sc., Mycologist, Government of West Bengal, State Agricultural Research Institute, 230, Netaji Subash Road, Tollygunge, Cal. 33.
- Chaturvedi, P. L.** Asst. Entomologist, Agricultural Gardens, Kanpur.
- Chhappgar, Sorab Kharshedji**, Professor of Chemistry, Shapur Bagh, B-6, (2nd Floor) V. Patel Road, Girgaon, Bombay 4.
- Chaudhuri, Anil**, M.Sc., M.B., D.T.M., Medical Practitioner and attached to R. G. Kar Medical College, 8, Ananda Banerjee Lane, P.O. Elgin Road, Calcutta.
- Chaudhuri, Abaninath**, Lecturer in Geology, University of Calcutta, Presidency College, Calcutta 12.
- Chaudhuri, (Prof.) A. K.**, Lecturer in Mechanical Engineering, University of Roorkee, Roorkee.
- Chaudhuri, B. N.** B.E., M.I.E., M.R.S.I., (Lond), Civil Engineer & Architects, 10, Hasting Street, Calcutta 1.
- Chaudhuri, (Dr.) B. N.**, Central Drugs Laboratory, 110, Chittaranjan Avenue Calcutta.
- Chaudhuri, D. K.** M.Sc., Ph.D., Research Officer, Nutrition Research Unit, I.C.M.R., Govt. of India Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Chaudhuri, Hiran C.** M.A., Ph.D. (Lond), Ph.D. (Edin.), F.R.S.E., Director of Agriculture, Government of West Bengal, Writers Building, Block B. (Top floor), Calcutta.

- Chaudhuri, Dr. Hari Shankar**, M.Sc., D.Phil., Professor of Zoology, Allahabad University, Allahabad.
- Chaudhuri, J. P.**, M.B., (Cal.), D.P.H. (Lond.), D.T.M. ((L'pool), D.P.H. (Edin.), Health Officer, District 1, Calcutta Corporation, 102/2, Serpentine Lane, Calcutta.
- Chaudhuri, K. C.**, 56/2, Creek Row, Calcutta.
- Chaudhuri, K. C.**, Chemist & Metallurgist, Locomotive Works, Jamalpur.
- Chaudhuri, Kantilal**, M.Sc., Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Chaudhuri, Manoranjan**, M.A., Professor of Geography, Vidyasagar College, 39, Sankar Ghosh Lane, Calcutta.
- Chawdhuri, Prafulla Chandra**, B.M.E., A.M.I.E., Lecturer, College of Engineering, 19, Station Road, Calcutta 31.
- Chaudhuri, Purnendu Kumar**, C/o. Mr. A. Sarma, Head Master, New Colony, Laitun Kharah. Shillong, Assam,
- Chaudhuri, Rai Hridindra Nath**, Research Scholar, Central Drugs Laboratory, "Munshi House," Baranagar, Calcutta 36.
- Chaudhuri, R. N.**, M.B., M.R.C.P., T.D.D., Professor of Tropical Medicine, Director, Calcutta School of Tropical Medicine, Central Avenue, Calcutta.
- Chaudhuri, S. S.**, A.I.E.E., Chief Engineer N. E. W. Mills, Dhariwal, Punjab, Engineer, G.E.C., (India) Ltd., Magnet House, Central Avenue, Calcutta.
- Chaudhuri, (Miss) Sujata**, M.R.C.P., (Lond.), M.R.C.P. (Endin), D.C.H., (Lond.), Professor of Medicine, Lady Hardinge Medical College for Women, New Delhi.
- *Chauhan, B.S.**, M.Sc., Ph.D., F.Z.S., Assistant Superintendent, Zoological Survey of India, Jabakusum House, Calcutta.
- Chavan, A. R.** B.Sc., Ph.D. (Neb. U.S.A.), Professor of Biology, Baroda College, Baroda.
- Chiplonkar, G. W.**, D.Sc., Reader in Geology, University of Saugar, C. P.
- Chiplonker, N. W.**, D.Sc., 'Herakles Home,' Poona 4.
- Chitale, (Mrs.), S.**, "White Hall," Congress Nagar, Nagpur.
- Chitre, G. D.**, Rao Bahadur, L.M.S., Plot No. 73, Superibag Road, Parel, Bombay.
- Chona, B. L.**, Ph.D. (Lond.), D.I.C., Indian Agricultural Research Institute, New Delhi.
- Chopra, B.N.**, D.Sc., F.N.I., Dy. Fishery Dev. Advisor to the Govt. of India, Ministry Agriculture, New Delhi.
- Chopra, Sir R. N.**, C.I.E., M.A., M.D., F.R.A.S B., F.N.I., Lt.-Col. I.M.S. (Retd.), Director, Drug Research Laboratory, Jammu & Kashmir State, Jammu Tawi.
- Choudhury, A.P.**, M.Sc., Asst. Tech. Officer, I.C.I. (India), Ltd., 18, Strand Road, Calcutta.
- Chowdhury, A. N.**, M.Sc., Asst. Chemist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Chowdhury, Amal Chandra**, M.Sc., D.Phil., Lecturer in Mathematics, Calcutta University, 7-A, Bagdipara Lane, Konnagar, Hooghly.
- Choudhury, Gour Chandra**, 10B, Nafar Kundu Road, Calcutta 26.
- Chowdhury, H. D.**, B.Sc., A.M.I., Mech.E., Director of Engineering, Home (Transport) Department, Government of West Bengal, P-11, Mission Row Extn., Calcutta.
- Chowdhury, J. K.**, M.Sc., Ph.D. (Berlin), F.N.I., Head of the Dept. of Chemistry, Bose Institute, 93, Upper Circular Road, Calcutta 9.
- Chowdhury, K. Ahmad**, M.B.E., D.Sc. (Edin.), M.Sc., F.N.I., Wood Technologist, Forest Research Institute, New Forest, P.O. Dehra Dun, U.P.

- Choudhury, S.**, B.Sc., Engg., A.M.I.M., C.I.E.C.O., Ltd., 138, Canning Street, Calcutta.
- Chaudhury, Subodh Gobinda**, D.Sc., Lecturer in Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Chaudhury, Satya Prosanna**, Engineering Overseer, Calcutta Corporation (Dist. No. 1), 68, Surendra Nath Banerjee Road, Calcutta 14.
- Chhabra, B.Ch.**, Government Epigraphist for India, Ootacamund, South India.
- Chib, R. C.**, Council of Scientific & Industrial Research, 'P' Block, Raisina Road, New Delhi.
- Chief Chemist**, The Bhagat Oil Mills, 32-4, Sahitya Parishad Street, Calcutta.
- Chunder, S. C.**, M.Sc., C/o. The Scientific Instrument Co., Ltd., 240, Hornby Road, Fort, Bombay.
- Creet, C/o. Creet Automobiles Ltd.**, Circus Avenue, Calcutta.
- Craftsman**, Electronics Corporation Ltd., Manufacturers of Industrial & Research Scientific Instruments, Navsari Buildings, 240, Hornby Road, Bombay.
- Cursetjee, (Miss) J. M.**, 'Behistan,' 169, Colaba Road, Bombay 5.

D

- Daji, (Dr.) J. A.**, B.Sc., Ph.D., Dy. Director of Agriculture (Research & Education), Central Buildings, Poona 1.
- Dakshy, S. N.**, B.Sc. (Cal.), B.E. (Elec.), Office of the Asst. Engineer, Western Electrical Sub-Division, No. 1, W. & B. Dept., Government of West Bengal, Kidderpore Bridge Approach, P.O. Hastings, Calcutta 22.
- Dalal, Phiroz Ardeshir**, L.M.S. (Bom.), D.T.M. & H. (Cam.), Professor of Bacteriology, Grant Medical College, 241, Princess Street, Bombay 2.
- Dangayach, K. B.**, Asst. Director of Commerce Industries (Statistics), Rajasthan, Jaipur.
- Das, Asoke**, M.Sc., Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Das, Atulananda**, F.L.S., I.F.S. (Retr.), F.L.S. (Lond.), F.S.S.E., Suren Kar's Bungalow, Santinivas, Birbhum.
- Das, Bhupendra Chandra**, M.Sc., Prof. of Mathematics, Presidency College, Calcutta 12.
- Das, Binod Lal**, Lecturer in Mechanical Engineering, 'Lal Kuthi' Jadavpur Colony, Calcutta 32.
- Das, Chittaranjan**, M.Sc., Assoc. I.A.R.I., Mycological Research Assistant, Department of Agriculture, Government of India, State Agriculture Research Institute, Tollygunge, Calcutta 33.
- Das, D. B.**, M.Sc., Ph.D. (Leeds), A.R.I.C. (Engl.), Senior Research Chemist, Group Laboratory, Messrs. Jardine Henderson Ltd., C/o. Baranagore Jute Factory Co., Ltd., Calcutta 35.
- Das, Ganadeb**, 15, Rama Prasad Roy Lane, Calcutta 6.
- Das, J. C.**, B.E.E., A.M.A.E.E., A.M.A.E., Consulting Electric & Mechanical Engineer, 78-A, Durga Charan Mitra Street, Calcutta 6.
- Das, K.N.**, M.Sc., Asst. Research Officer, Central Inland Fisheries Research Institute, Barrackpore, 14, Sita Nath Bose Lane, Salkia, Howrah.
- Das, Kamal Krishna**, Ex-Hony. Magistrate, Ex-Councillor, Corporation of Calcutta, 4A, Raja Raj Krishna Street, Calcutta 6.
- Das, Kanailal**, Parliamentary Secy. to K.L.S.G., Dept. West Bengal, 269, Vivekananda Road, Calcutta.
- Das, Nagendra Nath**, Lecturer in Physiology, University College of Science, 92, Upper Circular Road, Calcutta 9.

- Das, P. K., M.Sc. (Lond.), D.I.C., Meteriologist, Metallurgical Office, Ganeshkhind Road, Poona.
- Das, Rathis Kumar, B.Sc., Industrial Chemist, C/o. Capt. P. Deb, 127, Raja Dinendra Narayan Street, Calcutta 4.
- Das, S. C., M.B. (Cal.), Ph.D. (Edin.), F.R.S.E., Principal, Assam Medical College, Dibrugarh.
- Das, S. P., B.E., A.M.I.E., Civil Engineer, C/o. Braithwati Burn & Jessop Construction Co., Ltd., Post Box 264, Calcutta 1.
- Das, S. R., M.Sc., Asst. Radiologist, Dept. of Anthropology, Government of India, Indian Museum, Calcutta.
- Das, Sudhindra Nath, M.Sc., Asst. Professor, Chemistry, Science College, Patna 5.
- Das, Sudhir Ranjan, M.A., D.Phil, Lecturer, Department of Anthropology, University of Delhi, Delhi.
- Das, Tarak Chandra, M.A., Lecturer in Anthropology, University College of Science, 93, Ballygunge Place, Calcutta.
- Dass, C. M. S., Lecturer in Zoology, Central College, Bangalore 1.
- Das Gupta, A. B., The Divisional Geologist (Eastern Circle), The Burmah Oil Co. (I. C.), Ltd., Masimpur, Dist. Cachar, Assam.
- Das Gupta, C.R., M.B., D.T.M., Officer-in-Charge, Haematology Department, School of Tropical Medicine, Calcutta.
- Das Gupta, (Miss) Chinmoyee, 1-1, Ramanath Muzumder Street, Calcutta 9.
- Das Gupta, Gopal Chandra, Chief Chemist, National Tobacco Co. of India Limited, Agarpara, Kamarhati, 24-Parganas.
- Das Gupta, H. N., D.Sc., Professor of Chemistry and Applied Geography, Fuel and Metallurgy, Indian School of Mines, Dhanbad.
- Das Gupta, Jitendra Nath. B.A., B.E., M.I.E. (Ind.), M.A.E., M.R.San.I. (Lond.), M.I.R.C., M.R.A.S.B., Consulting Engineer (Retd. Chief Engineer, Town Planning, West Bengal), 27, Lansdown Terrace, Calcutta 26.
- Das Gupta, Kalyan, M.Sc., Bengal Immunity Co., Ltd., Baranagar P.O., 24-Parganas.
- *Das Gupta, Niroj, M.Sc., Ph.D., Reader in Biophysics, Calcutta University, Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta. Home—44 Hazra Road, Calcutta 19.
- Das Gupta, P. N., Professor of Mathematics, P.O. Kadamkuan, Patna 3.
- Das Gupta, (Dr.) P. R., M.B., Senior Visiting Physician, Lake Medical College Hospital, 1, Kabir Road, Calcutta 26.
- Das Gupta, S. M., M.Sc., Ph.D., Senior Lecturer in Chemical Technology, 8, Hasan Building, Nicholson Road, Kashmir Gate, Delhi.
- Das Gupta, Satyendra Sankar, B.Sc., B.T., 33, Satyen Roy Road, Behala, 24-Parganas.
- Das Gupta, Satindra, M.Sc., D.Phil., Research Chemist, B.C.P.W., 164, Maniktolla Main Road, Calcutta.
- Das Gupta, Sivaprasad, Lecturer in Geography, Presidency College, 126, Sovabazar Street, Top Floor, Calcutta 5.
- Das Gupta, Sushil, B.E.E., Electrical Engineer, 16, Syed Amir Ali Avenue, Calcutta.
- Dastur, (Dr.) Noshir S., Dairy Chemist, Indian Dairy Research Institute, Hosur Road, Bangalore 1.
- Dastur, R. H., M.Sc., F.N.I., Plant Physiologist, Institute of Plant Industry, Indore, (C. I.).
- Datt, J., B.A. (Hons.), C.E., A.M.I.E., Dt. Engineer, The Concrete Association of India, Exhibition Road, Patna.
- Datt, Narendra Lal, M.Sc., Research Assistant, Organic Chemistry Divn., National Chemical Laboratory, Poona.
- Datta, Amiya, M.Sc., Research Asst. C. S. I. R., Central Drugs Laboratory, Govt. of India, 1, Sudder Street, Calcutta 13.

- Datta**, Bimal Chandra, A.M.Inst.F., 20A, Garcha 1st Lane, Calcutta 19.
- Datta**, Chittatosh, M.Sc., Ph.D. (Lond.), D.I.C., 200/3B, Rash Behari Avenue, Calcutta 29.
- Datta**, Debabrata, Chemical Plant and Equipment Ltd., 7, Lower Chitpore Road, Lallbazar, Calcutta 1.
- Datta**, Debdas, Asst. Pharmacognosist, Pharmacognosy Section, Central Drugs Laboratory, 1, Sudder Street, Calcutta 13.
- Datta**, Dharendra Chandra, Asst. Chief Engineer & Under Secretary, P.W.D. Assam, 'Mahesh' Laiture Khrah, Shillong.
- Datta**, M. N., M.Sc., Asstt. Superintendent Zoological Survey of India, 34, Chittaranjan Avenue, Indian Museum, Calcutta 12.
- Datta**, S. K., M.Sc., A.Inst.P. (Lond.), Manager, The Scientific Industrial Co., Ltd., 30, Mount Road, Madras.
- Datta**, Sailesh, B.Sc., M.B., 9A, Manomohan Bose Street, Calcutta 6.
- Dutta**, Sunil Chandra, M.Sc., D.Phil., F.R.M.S., Pharmacognosist, Pharmacognosy Section, Central Drugs Laboratory, Govt. of India, Indian Museum. Cal. 13.
- Datta**, Tara Pada, B.E., M.I.E., F.A.P.I.C., F.A.M.U.S.T.M.A., Trade Mark, Patent and Design Attorneys and Engineers, Retd. Dy. Controller of Patents and Designs, 1-1, Rupchand Mukherjee Lane, Calcutta 25.
- Datta-Majumder**, N., B.L., M.A. (Econ.), M.A. (Anthrop.), Ph.D. (Anthrop.), F.R.A.S., 101A, Ballygunge Place, Calcutta.
- Datar**, D. S., M.Sc., Ph.D., A.I.I.Sc., Scientific Officer, Central Laboratories for Scientific and Industrial Research, Hyderabad-Deccan.
- Daver**, M. B., M.B.B.S. (Bom.), F.R.F.P.S.G. (Glas.), D.P.H. (Eng.), F.R.I.P.H. (Eng.), Asst. Director, Bureau of Nutrition, Hyderabad, 231-A, Maradpalli, Secunderbad, Deccan
- Dayal**, (Dr.) B., D.Sc., A.I.I.Sc., Asst. Professor of Physics, Benares Hindu University, Benares.
- Dayal**, Jagadeshwari, D.Sc., Lecturer in Zoology, Lucknow University Lucknow.
- De**, (Miss) Anjma, C/o. Mr. K. L. De, District Engineer, Calcutta Corporation, 97, Cornwallis Street, Calcutta.
- De**, (Mrs.) Ashalata, C/o. Mr. K. L. De, District Engineer, Calcutta Corporation, 79, Cornwallis Street, Calcutta.
- De**, A. K. Ph.D., D.I.C. (Lond.), Superintending Geologist, Geological Survey of India, 27, Chowringhee, Calcutta.
- De**, B. N., Fruit Research Station, Sabour (Bhagalpore).
- De**, H. P., M.Sc., Professor of Physics, Vidyasagar College, Calcutta.
- De**, K. L. District Engineer, District No. 1, Calcutta Corporation, 79, Cornwallis St., Calcutta.
- De**, K. N., B.Sc., M.B., F.C.C.P., Jr. Visiting Physician, Chest Dept., Medical College Hospital, 1/1, Radhanath Chowdhury Road, Calcutta 15.
- De**, M., B.S. (Engg.), Managing Director, C.I.E.O., Ltd., 138, Canning Street, Calcutta.
- De**, Nagendranath M.B., D.T.M. (Cal.), M.R.C.P. (Edin.), D.P.M. (Lond.), Lecturer in Psychology, Calcutta University, Visiting Physician-in-Charge of the 151/1, Cornwallis Street, Calcutta.
- De**, N. R., C/o. Agricultural Machinery Manufacturing Corporation Co. Ltd., 14/2, Bhaba Nath Sen Street, Calcutta.
- De**, P. K., M.Sc., Ph.D., Agricultural Chemist to the Govt. of West Bengal, P138, Lake Terrace, Calcutta.
- De**, Premankur, B.Sc., M.B. (Cal.), F.R.C.P. (Edin.), F.N.I., 172, Lansdown Road, Calcutta 29.

- De, S. C., M.A. (Pat.), M.A. (Cantab),** Asst. Professor of Mathematics, Bihar College of Engineering, P.O. Mahendray, Patna.
- De, S. S., M.Sc., D.Sc.,** Lecturer in Food Technology, Dept. of Biochemistry, Indian Institute of Science, Bangalore.
- De, Satyendra Nath,** C/o. Mr. K. L. De, Dist. Engineer, Calcutta Corporation, 79, Cornwallis Street, Calcutta.
- De Sircar, N., B.Sc.,** Bengal Immunity Co., Ltd., Baranagar P.O., 24-Parganas.
- Deb, Ajit Kumar, M.Sc., M.B., D.P.H. (Lond.),** 52, Braja Nath Dutta Lane, Calcutta 12.
- Deb, Dr. B. C.,** Chief Research Officer, Central Water Power Irrigation & Navigation Research Station, Poona.
- Deb, Chandi Charan, M.Sc.,** Dept of Physiology, Presidency College, Calcutta 7.
- Deb, Dharendra Kumar,** P.O. Jadabpur College, Calcutta 32.
- Deb, S.,** Prof. of Geography, College of Engineering and Technology, Jadabpur (W. B.), 8/1, Dover Lane, Calcutta.
- Deb, (Mrs.) Santa, M.A., B.T., T.D. (Lond.),** Dept. of Psychology, University College of Science, Home: 8/1, Dover Lane, Calcutta.
- Deekshatulu, M. N., B.Sc. (Hons.),** Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Dehadral, P. V.,** Lecturer, Dept. of Geology, University of Saugar, Saugar, C. P.
- Deolakar, T. K., M.A.,** Professor and Head of the Dept. of Physics, Pratap College, Amalner (East Khandesh 4.)
- Deoras, P. J., M.Sc., L.L.B., Ph.D.,** Haffkine Institute, Parel, Bombay 12.
- Deputy Chief Controller of Standardization,** Central Standards Office for Railways, 'N' Block, Raisina Road, New Delhi 2.
- Deputy Director General of Observatories,** Climatology & Geophysics, Poona 5.
- Desai, A.D., B.Sc., B.Ag., Ph.D.,** Govt. Agricultural Chemist, Main Marm, Himayatsa Hydrabad, Deccan 5.
- Desai, Dr. R. D., M.Sc., (Bom.), D.Sc., (Lond.), F.N.I., F.I.I.Sc., F.A.Sc., D.I.C.** Principal L. D. Arts College & M.G. Science Institute, Navarangapura, Ahmedabad 9.
- *Desai, Shrishkhant Varajray, D.Sc., (B.Sc.) Ph.D., (Lond.), D.I.C.,** 2nd Agricultural Chemist, Indian Agricultural Research Institute, New Delhi.
- Desai, V. M., F.D.S., R.C.S., D.D.S., F.I.C.D.,** Dean-Nair Hospital Dental College, Lamington Road, Bombay 8.
- Desappa, (Dr.) B.,** Senior Lecturer, Agricultural College, Hebbal P.O., Bangalore.
- Deshpande, B. G.,** Geological Survey of India, Botawala Chambers, Sir Phirozshah Mehta Road, Bombay 1.
- Devi, (Miss) P., M.Sc., Ph.D.,** Asst. Dairy Technologist, Indian Dairy Research Institute, Bangalore 1.
- Dewan, R. N., M.Sc.,** 5, Doctor's Lane, New Delhi.
- Dey, A. K., Ph.D., D.I.C. (Lond.),** Superintending Geologist, Geological Survey of India, Southern Circle, 4-5D, Silva Road, Madras 4.
- Dey, B. B., M.Sc., (Cal.), D.Sc. (Lond.), F.I.C.F.N.I., I.E.S.,** Director of Public Instruction, P.O. Mylapore, Madras 4.
- Dey, Deben,** Director, Indian Shellack Industries Ltd., 31, Liuton Street, Calcutta 14.
- Dev & Paul Co.,** Building Contractors, 243, Upper Circular Road, Calcutta.
- Dhar, (Dr.) A. N., Ing. (Dresden.), B.Sc., M.I.S.E. (Cal.),** Provincial Industrial Research Laboratory, Science College, Patna.
- Dhar Chaudhury, S. C., B.Sc.,** Bengal Immunity Company, Limited, Baranagar P.O., 24-Parganas.
- Dhar Gupta, Kalipada,** Mechanical Draftsman, 3/23, Vivek-Nagar, Jadavpur, Calcutta 32.

- Dhar, J.**, M.Sc., D.Phil., A.Inst.F., F.G.M.S., Head of the Department of Physics and Mathematics, Indian School of Mines, Dhanbad.
- Dhar, M. L.**, M.Sc., Ph.D., F.R.I.C., Asst. Director (Chemistry), Central Drugs Research Institute Chattar Manzil Palace, Lucknow.
- Dhar, Manoj Mohan**, A.I.S.M., M.M.G.I., F.G.M.S., Consulting Geologist, C/o. Mineral Prospecting Syndicate Ltd., 7, Old Post Office Street, Calcutta 1.
- Dhavale, D.G.**, 840, Deccan Gymkhana, Poona 4.
- Dhingra, D.R.**, M.Sc., Ph.D., Industrial Chemist to Govt. of U.P., Harcourt Butler Technological Institute, Cawnpore.
- Dholakia, J.K.**, M.I.M.E., King Engineer, Bhurangya Colliery, P.O. Mohoder, Mandhum.
- Director**, of Agriculture, Assam, Shillong.
- Director**, General of Observatories, New Delhi.
- Director**, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Director**, Geological Survey of Pakistan, Post Box No. 15, Quetta, Beluchistan.
- Director**, Regional Meteorological Centre, Calcutta.
- Dixit, K. R.**, Professor of Physics, Royal Institute of Science, Mayo Road, Bombay 1.
- Dixit, P. D.**, Asst. Director of Agriculture, Seed Multiplication Scheme Orissa, Cuttack.
- Dixit, S. C.**, Major, M.A., M.Sc., Staff Officer, H. Q. 20-DIV, Fort William, Calcutta 21.
- Dixit, V. M.**, M.Sc., Pricurose Villa, Opp. Head Post Office, Dharwar.
- Dixitulu, J. V. H.**, M.Sc., Fishery Research Officer, Rajahmundry, Madras.
- Dogra, J. R.**, Asst. Director, Haffkine Institute, Parel, Bombay 12.
- Doja, M. Q.**, B.Sc. (Pat.), B.A. (Cantab.), A.R.I.S., Professor of Organic Chemistry and Head of the Department of Chemistry, Science College, Patna.
- Dole, Krishnaji Khando**, M.Sc., Ph.D., Professor of Chemistry, Ferguson College, Poona.
- Dongre, M. B.**, M.Sc., Chitnavis Research Fellow, University Department of Bio-Chemistry, Nagpur.
- Dongre, R. V.**, Dongre Building, 384, Farnington Road, Bombay 4.
- Doss, K. S.** Gururaja, D.Sc., F.I.C., A.Inst.P., F.A.Sc., Head of the Dept. of Chemistry Indian Institute of Sugar Technology, Cawnpore.
- Dubey, R.**, Head of the Department of Geography, Allahabad University, Allahabad.
- Dutt, A. B.**, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Dutt, Jagadindu**, B.M.E., Plants & Machinery Maintenance and Erection Engineer, M/s. Bhartia Electric & Steel Co., Ltd., 8, Swinhoe Street, Calcutta 19.
- Dutt, K. C.**, Asst. Electrical Engineer, Aviation & Electrical Sub-Division No. 1, C.P.W.D., Calcutta Air Port, Dum Dum.
- Dutt, Kaviraj Atul Behari**, B.Sc., Kaviratna, Superintendent, Bangiya Unmad Assram 29A, Vivekananda Road, Calcutta 7.
- Dutt, (Miss) Mridula**, M.A., Bose Research Institute, 93, Upper Circular Road, Calcutta 9.
- Dutt, M. N.**, B.Sc., Glasgow Electrical Engineer, Central Electrical Div. No. 2, C. P. W. D. Avenue House, Chowringhee Sqr., Calcutta.
- Dutt, N. L.**, M.Sc., Sugarcane Expert, Government of India, Sugarcane Breeding Station, Lawley Road, Coimbatore, S. India.
- Dutt, Purnendu Narayan**, 79, Bechu Chatterjee Street, Calcutta 9.
- Dutta, R.**, Inspecting Officer, Directorate of Inspection, S. & D. Department, 1, Ganesh Chandra Avenue, Calcutta.
- Dutt Roy, R. K.**, Calcutta.
- Dutta, S. C. A.**, D.Sc., M.R.C.V.S., D.V.M., F.N.I., Director, Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P.

- Dutta**, S. K., M.Sc., Metallurgical Laboratory, Inspectorate of Metal & Steel, Ishapur, West Bengal.
- Dutta**, Sakti Kumar, Electrical Engineer, Assam Railway, Katiahar.
- Dutta**, Satyendra Prosad, M.Sc., Bose Research Institute, 93, Upper Circular Road, Calcutta 9.
- Dutt**, Sudhir Chandra, Major, M.B., I.M.B. (Retd.), 8, Little Russel St., Calcutta 16.
- Dutta**, Amiya Bhusan, A.M.A.E., Civil Engineer, M/s. Sone Valley Portland Cement Co., Ltd., P.O. Japla (E. I. R.), Palamou.
- Dutta**, Arun Kumar, D.Sc., F.N.I., Mayurbhanj, Prof. of Physics, University College, Utkal.
- Dutt**, Brajendra Chandra, B.Sc., Bengal Immunity Company, Limited, Baranagar P.O., 24-Parganas.
- Dutta**, N. K., M.B.B.S., D.Phil. (Oxon.), M.B.P.S. (Oxon.), Asst. Director, Haffkine Institute, Parel, Bombay 12.
- Dutta**, P. K., Colliery Manager, Canshadih Colliery, P.O. Kusenda, Manbhum.
- Dutta**, S. R., A.M.A.E., Sub-Divisional Officer, M.E.S., Allahabad.

E

- East India** Distillers & Sugar Factories Ltd., The Nellikuppam, S. A. District.
- Ekambaram**, S. K., M.A. (Cantab.), 151, Narayan Pillay Street, Civil Station, Bangalore 1.
- Economic** Intelligence Director of Statistics, Economic and Statistics Dept., U. P. Civil Secretariat, 9, Sarojini Naidu Marg, Lucknow.
- Esh**, G. C., M.Sc., Ph.D. (Ohio), F. Sigma. XI (U.S.A.), Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Evans**, Percy, B.A., F.G.S., F.N.I., Geologist, The Burmah Oil Co., Ltd., Britannia House, Finsbury Circus, London, E. C. 2, England.

F

- Farooq**, M. Omar, Dept. of Chemistry, Muslim University, Aligarh.
- Fermor**, Sir Lewis Leigh, Kt., O.B.E., D.Sc. (Lond.), A.R.S.M., M.Inst., M.M., F.G.S., F.R.S., F.N.I., F.R.A.S.B., Late Director, Geological Survey of India, 24, Durdham Park, Bristol 6, England.
- Fowler**, Gilbert J., D.Sc., F.R.I.C., F.R.San.I., F.N.I., Hon., F.I.S.E., Central Hotel, Bangalore 1.

G

- Gadgil**, J. S., M.Sc., R.B.D., C/o. Dr. S. R. Jogiekar, 64, Hugues Road, Grant Road, Bombay 7.
- Gafar**, Syed Khaja Abdul, H.C.S., Director, Soil Survey Dept., Central Secretariat Buildings, Hyderabad—Deccan.
- Ganapati**, S. V., M.Sc., A.R.I.C., Hydrologist, Fisheries, Fresh-water Biological Research Station, Klipauk, Madras.
- Ganguli**, A. K., General Manager, The Scientific Instruments Co., Ltd., 11, Esplanade East, Calcutta.
- Ganguli**, Arun, Z.D.S. (Vienna), 26, Chowringhee Road, Calcutta.

- Ganguli, D., Asst. Mycologist, Central Rice Research Institute, Cuttack 4.
- Ganguli, Dharendra Nath, L.C.E., A.M.I.B.E., A.M.A.E., Engineer, M/s. Talbot & Co., Tower House, Chartered Surveyors, Chowringhee Square, Calcutta.
- Ganguli, J., B.E., M.I.E. (Ind.), Chartered Engineer (India), 6, Hastings Street, Calcutta.
- Ganguli, Sudhir Chandra, B.Sc., B.M.E., A.M.I.E., Asst., Engineer, 16, Manohar-Pukur 2nd Lane, Calcutta 29.
- Ganguly, Amalendu, Ph.D. (Edin.), Bose Research Institute, 93, Upper Circular Road, Calcutta 9.
- Ganguly, Dharendra Nath, M.Sc., D.Phil., Lecturer, Dept. of Zoology, University College of Science, 35, Bullygung Circular Road, Calcutta.
- Ganguly, Dwijendra Nath, B.E., M.A.E., Chief Engineer, Corporation of Calcutta, 17, Sham Square, Calcutta 3.
- Ganguly, Mohit Kumar, Asst. Research Officer, Central Water-power Irrigation and Navigation Research Station, Poona.
- Ganguly, S. K., M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Grade, G. M., Technical Chemist, Jeewajiganj, Lasakar Gwalior C.I.
- Ganiwar, T. N., 40, Chiford Place, P.O. Ambala Pilya, Mathakkuliya.
- Garg, Shiva Chandra, B.Sc., LL.B., M.I.S.I., Statistician, Land Records Department, Government of Rajasthan, Krishna Chowk, Kaisarganj, Ajmer.
- Gayen, Anil Kumar, M.A., Ph.D. (Cantab.), Professor Training Section, Indian Statistical Institute, Presidency College, Calcutta.
- General Manufacturing Company., The (Manufacturers of Balances and Scientific Instruments), Sonarpura, Banares.
- *Ghadialy, Pestonji F., F.R.G.S., F.R.S.A., F.B.H.I. (Lond.), M.M.E.A., A.M.A.E., M.I.S.E., C/o. Ragers Watch Co., 317, Hornby Road, Fort, Bombay.
- Ghandy, Sir Jehangir J., Kt., C.I.E., B.A., B.Sc., M.I.E., F.Inst.F., M.I.S.I., Agent Tata Iron & Steel Co., Ltd., 102A, Netaji Subhas Road, Calcutta.
- Ghani, M.A., M.Sc., Senior Scientific Assistant, Central Leather Research Institute, Madras 15.
- Gharpure, D. M., M/s. Gharpure & Co., 129, Radhabazar Street, Calcutta.
- Gharpure, D. M., M/s. Scientific Indian Glass Works Ltd., 98, Christopher Road, Calcutta 14.
- Gharpure, (Maj.), P. B., M.D., D.T.M., & H., Professor of Pathology, Grant Medical College, Bombay 8.
- Ghatak, Narendranath, D.Sc., Chemical Examiner to Govt. of U. P. & C. P., Agra.
- Ghose, K. D., M.A. (Oxon.), D.Litt, Dip-in-Ed., Barrister-at-Law. Principal, David Hare Training College, 25/3, Ballygange Circular Road, Calcutta.
- Ghose, S. K., M.Sc., Geologist, Hindusthan Minerals and Natural History Specimen Supply Co., 39, Russa Road, Tollygunj, Calcutta.
- Ghose, Sachindra Kumar, B.E.E., A.M.I.E., S.D.O., Electrical Sub-Division, Chinsura.
- Ghose, Sudhir Kumar, M.B., (Cal.), D.T.M., (L'pool), Chief Analyst, Calcutta Corporation, 23/1, Beniatolla Street, Calcutta.
- Ghosh, A. K., M.Sc., Registrar, Bose Institute, 93, Upper Circular Road, Calcutta.
- Ghosh, A. M. N., B.Sc., (Cal.), B.Sc., (Hons.), (Lond.), A.R.C.S., (Lond.), Superintending Geologist, Geological Survey of India, 27, Chowringhee, Calcutta.
- Ghosh, A. P., Retd. Slipper Controller Officer, Government of India, 14-2, Bhaba Nath Sen Street, Calcutta.
- Ghosh, Asoke, Lecturer in Biology, Bangabasi College, 25/1, Scott Lane, Cal. 9.

- Ghosh, B. N.,** M.B.E., F.R.F.P. & S., (Glass.) L.M., (Dublin), F.R.S. (Edin), F.S.M.F. (Bengal), Professor of Pharmacology, R. G. Kar Medical College, Calcutta.
- Ghosh, B. N.,** D.Sc., F.N.I., Department of Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Ghosh, Bidhu Bhushan,** B.E., C.E., A.M.I.E., M. Amer. Soc. R.E., A.M., Amer. Soc., H.V.E., Deputy Director (Civil Engineering), Department of Supply, Government of India; 47, Southern Avenue, Calcutta 29.
- Ghosh, Birendra Nath,** M.Sc., Department of Statistics, Presidency College Calcutta.
- Ghosh, Bireswar Prosad,** B.M.E., Lecturer, C.E.T. (Bengal), Jadavpur, 26, Lake Avenue, Calcutta 26.
- Ghosh, Chandra Sekhar,** M.Sc., (Cal.), S.M., (M.I.T.), A.M.A.I.E., M.I.E.S.A., Professor of Electrical Engineering, (Dept. of Power Engineering) Indian Institute of Science, Bangalore 3.
- Ghosh, Gopal Krishna,** B.Sc., M.B., (Cal.), M.Sc., (Lond.), Head of the Department of Anatomy, P. W. Medical College, Bankipore P.O., Patna.
- Ghosh, (Miss), Gouri,** B.Sc., Research Scholar, Department of Zoology, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Ghosh, H.,** M.B. (Cal.), M.S.P.E., (Paris), Scientific Director, M/s. Standard Pharmaceutical Works Ltd., 67, Dr. Suresh Sarkar Road, Entally, Calcutta 14.
- Ghosh, H.,** Scientific Director, M/s. Standard Pharmaceutical Works Ltd., 67, Dr. Suresh Sarkar Road, Calcutta.
- Ghosh, H. K.,** C/o. Mr. B. K. Sarkar, 14/2, Bhaba Nath Sen Street Calcutta.
- Ghosh, J.,** M.A., (Cal.), Ph.D. (Edin), F.N.I. 9, Satyen Dutta Road. Calcutta 29.
- Ghosh, (Sir), Jan Chandra, Kt.,** D.Sc., F.N.I., Director, Indian Institute of Technology, 5, Esplanade East, Calcutta 1.
- Ghosh, Jagat Jiban,** M.Sc., D.Phil, Research Assistant, Indian Council of Medical Research, Department of Applied Chemistry, 92, Upper Circular Road, Calcutta 9.
- Ghosh, Lalmohan,** B.E.E., A.M.E.E., Electrical Power Engineer, Shift Charge Engineer, The Calcutta Electric Supply Co., 38, European Asylum Lane, Calcutta 16.
- Ghosh, (Dr.) L. M.,** M.B., (Cal.), D.T.M., (L'pool), Dept. of Dermatology, School of Tropical Medicine, 74/4, Baghbazar Street, Calcutta 3.
- Ghosh, M. M. L.C.P.S.** (Bombay), Suitanpura, Baroda.
- Ghosh, Nares Chandra,** M.Sc., Research Worker, I.R.F., School of Tropical Medicine, Calcutta.
- Ghosh, Naresh Chandra,** M.Sc., D. Phil. Dept. of Physiology, Presidency College, Calcutta.
- Ghosh, N. L.,** M.Sc., Surendra Nath College, Calcutta.
- Ghosh, Nripendra Nath,** M.Sc., 15A, Beltala Road, Calcutta 26.
- Ghosh, (Prof.) P. B.,** B.S., (Hons.), B.E.C., M.I.E., (India). Principal, Calcutta Engineering Institute, 50Z, Garcha Road, Calcutta 19.
- Ghosh, P. K.,** Lecturer Department of Applied Mathematics University College of Science, 92, Upper Circular Road, Calcutta 9.
- *Ghosh, Prashanta Kumar,** M.B., D.T.M. (Cal.), M.R.C.P. (Lond.), M.R.C.P. (Edin.), F.C.C.P. (N.Y.), Senior Physician, Mayo Hospital & R. G. Kar Memorial Hospital, 22, Nilmoni Mittra Street, P.O., Calcutta 6.
- Ghosh, P. K.,** Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Ghosh, P.N.,** C/o. Mr. B.K. Sarkar 14/2. Bhaba Nath Sen Street, Calcutta.
- Ghosh, Ram Lal,** C/o. Mr. B. K. Sarkar, 14/2, Bhaba Nath Sen Street, Calcutta.

- Ghosh**, Rabindra Mohan, B.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Ghosh**, S., D.Sc., F.N.A.Sc., Reader Chemistry Department, University of Allahabad, Allahabad.
- Ghosh**, S., D.Sc., Department of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.
- Ghosh**, S. K., Managing Director, Instrument Research Laboratory, Ltd., 309, Bow-bazar Street, Calcutta 12.
- Ghosh**, S. M., M.B., Asst. Professor of Medical Entomology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Ghosh**, S. P., M.A., Asst. Lecturer, Department of Psychology, University College of Science, 92, Upper Circular Road, Calcutta.
- Ghosh**, S. K., B.Sc., F.S.A.A., F.C.A., 2/2, Elgin Road, Calcutta 20.
- Ghosh**, S. N., B.C.P.W., 164, Manicktolla Main Road, Calcutta.
- Ghosh**, S. S., M.Sc., F.B.S., Assistant Wood Technologist, Forest Research Institute, New Forest P.O., Dehra Dun.
- Ghosh**, Sashadhar, Ludlow Jute Co. Ltd., Chengail, Howrah.
- Ghosh**, Sudhamoy, D.Sc., F.R.I.C., F.N.I., Emeritus Professor, Calcutta School of Tropical Medicine, 15, Justice Chandra Madhav Road, Calcutta 20.
- Ghosh**, Sudev Bhusan, M.Sc., Dept. of Biology, Bangabasi College, Calcutta.
- Ghosh**, Satya Ranjan, B.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Ghosh**, Sudhir Mohan, M.Sc., B.Com., B.T., D.S.E., Professor & Head of the Dept. of Geography, Vidyasagar College, 30, Sankar Ghosh Lane, Calcutta 6.
- Ghosh**, Sachindra Nath, A.M.E.E., Electrical Contractor, 90, Bechu Chatterjee Street, Calcutta.
- Ghosh**, Sailendra Nath, B.M.E., A.M.M.E., Technical Assistant to the Government of West Bengal, Department of Supplies, 125, Lansdown Road, Calcutta 26.
- Ghosh**, Srikanta Kumar, B.E.E., X-ray Engineer, C/o. S. J. H. K. Ghosh, M.A., B.L., Pleader, 9, Dehi Entally Road, Calcutta 14.
- Ghosh**, Suchit Kumar, B.E., A.M.I.E. (India), Executive Engineer (W. & B.), Government of West Bengal, Murshidabad Construction Division, Beharampur, Murshidabad.
- Ghosh**, T., Statistician, United Commercial Bank Ltd., 2, Royal Exchange Place, Calcutta.
- Ghosh**, T., M.Sc., Asstt. Mycologist, Jute Agricultural Research Institute, Hooghly, West Bengal.
- Ghosh**, T. K., Manager, Messrs. B. K. Paul & Co., Ltd., 1, Bonfield Lane, Calcutta.
- Ghosh**, T. N., D.Sc., Bengal Immunity Research Institute, 39B, Lower Circular Road, Calcutta 16.
- Ghosh**, (Dr.) T. N., Publicity Officer, Bengal Chemical and Pharmaceutical Works, Ltd., 164, Maniktollah Main Road, Calcutta.
- Ghosh**, Tarit Kumar, M.D. (Cal.), Physician, R. G. Kar Medical College, 60, Baje Shibpur Road, Shibpur P.O., Howrah.
- Ghoshdastidar**, Girindra Nath, Overseer, Water Works Department, Corporation of Calcutta, 34A, Monmatha Dutta Road, Calcutta 37.
- Ghosal**, Amiya Kumar, M.Sc., Department of Chemistry and Bio-Chemistry, Nilratan Sarkar St. Calcutta.
- Gideon**, P. W., M.A., Professor of Biology, Karnatak College, Dharwar, Bombay.
- Godbole**, R. D., M.Sc., Ramnarain Raia College, Matunga, Bombay 19.
- Godbole**, S. N., Rao Saheb, M.Sc., Dhantoli, Nagpur.
- Goel**, B. P., Inspector of Works, E. I. R., Aligarh.

- Gogate, D. V.**, M.Sc., Ph.D. (Lond.), Professor Physics, Baroda College, Baroda.
- Gokhale, A. G.**, M.A., B.Sc., F.R.I.C., A.I.Sc., "Prakash" Nasik.
- Gokhale, Shankar Kashinath**, B.A. (Hons.), M.Sc., A.I.I.Sc., F.R.I.C., Lecturer in Bio-Chemistry, B. J. Medical College, Poona.
- Gollerkeri, P. G.**, M.D., Professor of Pathology, Pathology Department, B. J. Medical College, Poona 1.
- Gonsalves, (Mrs.) E.**, B.A., M.Sc., Lecturer in Biology, Karnatak College, Dharwar.
- Gopal, Dr. Ram**, M.Sc., Ph.D., Lecturer in Chemistry, Lucknow University, Lucknow.
- Gopalakrishnan, V.R.**, Rao Saheb, G.M.V.C., P.G., Asst. Research Officer, Indian Veterinary Research Institute, Mukteswar, Kumaun.
- Goswami, Anil Prosanna**, M.Sc., Ph.D. (Lond.), D.I.C., Sir P. C. Ray, Fellow of Calcutta University Applied Chemistry Department, University College of Science, 92, Upper Circular Road, Calcutta.
- Goswami, (Dr.) M. N.**, Head of the Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Goswami, Madhab Chandra**, M.A., Lecturer-in-Charge of Anthropology, University of Gauhati, Gauhati, Assam.
- *Goswami, S. K.**, B.E., Assistant Engineer-in-Charge, C. E.'s Drawing Office, I. & W. Directorate, Writers' Buildings, Calcutta.
- Gowda, B. N.**, M.Sc., Doctorate Scholar, Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Greval, S. D. S.**, B.Sc., M.D., Ch.B., D.P.H., I.M.S., Serologist and Chemical Examiner to Government of India, School of Tropical Medicine, Calcutta.
- Guha, A.**, M.B.B.S., D.Bact., 47A, Lake Avenue, Calcutta 29.
- Guha, Amia**, B.Sc. (Eng.), A.M.I.E., Engineer, C. E. S. E. Ltd., 244C-1, Vivekananda Road, Calcutta 9.
- Guha, B. C.**, Ph.D., D.Sc. (Lond.), F.N.I., Member, Damoder Valley Corporation, Anderson House, Alipur, Calcutta.
- Guha, B. S.**, M.A., A.M., Ph.D., F.R.A.S.B., F.N.I., Director, Dept. of Anthropology, Anthropological Adviser to the Govt. of India, Indian Museum, Calcutta 13.
- Guha, Dilip Kumar**, B.Ch.E., Chemical Engineer, C/o. Mr. K. D. Roy Chowdhury, 3-8, Gora Chand Bose Road, Flat No. 1, Calcutta 6.
- Guha, P. C.**, D.Sc., F.N.I., Professor of Organic Chemistry, Indian Institute of Science, Malleswaram, Bangalore.
- Guha, P. C.**, D.Sc., Eng. (Manch.), Mechanical & Electrical Executive Engineer, Moore Canal Project, Suri P.O., Birbhum.
- Guha, S. C.**, M.B., F.R.F.P. and S., 47A, Lake Avenue, Calcutta 29.
- Guha, Subodh Chandra**, B.Sc., Bengal Immunity Company, Limited, Baranagar P.O., 24-Parganas.
- Guha-Sarkar, Sarbbani Sahay**, D.Sc., D.I.C., Prof. of Chemistry, Chemical Laboratory, Ravenshaw College, Cuttack, Orissa.
- Guleri, (Major) J. S.**, E.D., M.A., LL.B., P.A.S. (Retd.), Chief Statistical Officer, Government of Rajasthan, Department of Commerce & Industry Bureau of Statistics, Jaipur.
- Gulvady, (Miss) Lily**, Indian Dairy Research Institute, Bangalore.
- Gulvady, Madhukar**, 19, Appajappa's Agrahar, Chamarajpet, Bangalore 2.
- Gupta, A.K.**, B.A. (Cantab.), 19, Willot Road, Ballard Estate, Bombay.
- Gupta, Arun Kumar**, Lecturer College of Engineering and Technology, Bengal, 17B, South End Park, Calcutta 29.
- Gupta, Bireswar**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Gupta, Hansraj**, M.A., Ph.D., P.E.S., Government College, Hoshiarpur East Punjab.
- Gupta, (Mrs.) Hashi**, M.A., 9/6/1E, Pearymohan Sen Lane, Calcutta.

- Gupta**, (Dr.) Jagannath, Assistant Director, National Chemical Laboratory, Poona 7.
- Gupta**, Kalyan Kar, B.Sc., 16, Netaji Subhas Road, Calcutta.
- Gupta**, Krishna Murari, Engineer, Hind Construction Ltd., 9, Brabourne Road, Calcutta.
- Gupta**, L., Chemical Engineer, and Consulting Chemist, 227, Napier Town, Jubbulpore.
- Gupta**, N. N., M.Sc., Research Physicist, Indian Association for the Cultivation of Science, Jadabpur, Calcutta 32.
- Gupta**, F. D., Lecturer in Zoology, Lucknow University, Lucknow.
- Gupta**, S., M.Sc., P.R.S., F.N.I., Reader in Theoretical Physics, Muslim University, Aligarh.
- Gupta**, Santosh Kumar, M.B., D.T.M., School of Tropical Medicine, Calcutta.
- Gupta**, Subodh Chandra, M.B., (Cal.). Asst. Surgeon Superintendent, B.I.S.N. Co., Ltd., 16, Strand Road, Calcutta.
- Gupta**, S. R. B.Sc. F.R.M.S., Dy, Supt. of Police, in-Charge Finger Print Bureau & Scientific Section, C.I.D., U. P., Allahabad.
- Gupta**, Tamohar, Radio Lamp Works Ltd., Shikohabad.
- Guria**, Sasanka Sekhar, Bill-Overseer, Corporation of Calcutta, (Dist-1), 364, Grand Trunk Road South, Howrah.

H

- Hal**, M. A., Khan Sahib, M.D. M.R.C.P. (Edin), T.D.O. (Wales), Lecturer in Medicine, P. W. Medical College, Patna.
- Halder**, C. K. M.Sc., A.M.E., A.M.I. Prof. E. (Lond.), Asst. Superintendent of Development Weapons, Technical Development Establishment (Weapons), Gun & Shell Factory, Calcutta 2.
- Hamied**, K. A., M.Sc., M.A., Ph.D. (Boston), F.C.S. (Lond.), Managing Director, Cipla Laboratories, 289, Bellasis Road, (Byculla) Bombay.
- Hardikar**, S. W., M.D., M.R.C.P. (Edin), Professor of Pharmacology, Osmania Medical College, Hyderabad-Deccan.
- Harper**, A. Edwin, Jr., M.A., Ph.D., Psychologist, Head of the Dept. of Psychology, Education & Counselling, Ewing Christian College, Allahabad 3.
- Haltiangadi** R. R., M.A. M.Sc., Ph.D. D.I.C., The Associated Cement Co. Ltd., Esplanade House, Wandby Road, Bombay.
- Harrison**, C. J., B.Sc., O.B.E., Chief Scientific Officer, Indian Tea Association, Tockli, Experimental Station, Cinnamara P.O., Assam.
- Hart**, C. A., T.D., D.Sc., Ph.D., M.I.C.E., etc., Vice-Chancellor, University of Roorkee, Roorkee, U. P.
- Hatwaine**, V. G., M.Sc., 1st R.B.D., Lakshminarayan Fellow, Department of Biochemistry, Nagpur University, Nagpur.
- Hazra**, A. K., M.B.B.S., D.T.M., Senior Bacteriologist, Haffkine Institute, Parel, Bombay 12.
- Hazra**, (Dr.) S. N., Registered Medical Practitioner, Lodna P.O., Jharia, Manbhum.
- Hind Chemicals Ltd.**, Manufacturing Chemists & Pharmacists, Dist. Kanpur.
- Hirachand**, Lalchand, M.L.A., Constructions House, Wittet Road, Ballard Estate, Bombay.
- Hora**, Sunder Lal, Rai Bahadur, D.Sc. (Punjab) et Edin.), F.L.S., F.Z.S., F.R.S.E., F.N.I., F.R.A.S.B., Director, Zoological Survey of India, Jabakusum House, 34, Chittaranjan Avenue Calcutta.

- Hunday**, A. S. L. S., Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Husain**, Dildar, B.E., M.I.E., Chief Engineer, Irrigation, (Rtd.), "Raiz" Jubilee Hill, Hyderabad, Deccan.
- Husain**, Zakir, M.A., Ph.D., Vice-Chancellor, Aligarh University, Aligarh.
- Husani**, S. M., Central Laboratories for Scientific & Industrial Research, Narayanguda Section, Distillery Compound, Hyderabad-Deccan.
- Husian**, M. Afzal, Khan Bahadur Mian, M.A., (Cantab.), M.Sc., (Panp.), F.N.I., Chairman Joine Public Service Commission, Karachi.
- Husian**, S. K. Mahabood, Deputy Director, Social Service Department, Central Secretariat Building, Saifabad, Hyderabad-Deccan.
- Hussian**, Dr. Syed, M.Sc., Ph.D., (Lond.), Head of the Department of Chemistry, Faculty of Science, O. I. Hyderabad Deccan.
- ***Hutton**, J. H. C.I.E., M.A., D.Sc., I.C.S., F.N.I., F.R.A.S.B., University Museum of Archaeology and Ethnology, Downing Street, Bambridge, England.

I

- Indian Association for the Cultivation of Science**, Jadabpur, Calcutta 32.
- Indian Central Jute Committee**, 4, Hastings Street, Calcutta.
- Indian Science News Association**, 92, Upper Circular Road, Calcutta.
- Indian Veterinary Research Institute**, The Director, Muktesar-Kumaun, U.P.
- Indian Wood Products Co. Ltd.**, Bareilly, Izatnagar, U.P.
- Irani**, (Miss) R. J., "Roshni" off Cathedral Road, Madras, 6.
- Iyengar**, M. O. P., M.A., Ph.D., F.L.S., F.N.I. (Retd.), Director, University Botany Laboratory, Triplicate, Home: 71, R. V. Pillai Street, Madras.
- Iyengar**, N. K., Biochemist, Central Drugs Laboratory, 110, Chittaranjan Avenue, Calcutta 12.
- Iyer**, (Professor) A. R., Asst. Engineer, U. P. Government Work-shape, Roorkee.
- Iyer**, K. Sitarama, M.A., Chalai St., Trivandrum, Travancore
- Iyer**, L. A. N., Rao Bahadur, C/o. Post Master, R. S. Puram P. O. Coimbatore, S. India.
- Iyer**, R. S. Ramasubba, B.A. (Hons), 2/9, Broadway, Madras 1.
- Iyer**, S. G. G.M.V.C., Officer-in-Charge, Poultry Research Station, Indian Veterinary Research Institute, Izatnagar.
- Iyer**, S. N. Venkatarama, Provincial Marketing Officer, Khaleel Mansion, Madras 2.
- Iyer**, S. Narayana, M.A., A.T.T.Sc., F.R.I.C., Government Analyst, King Institute, Guindy, Madras 15.
- Iyer**, S. Rama, K.I.H., L.M., & S., Retired Civil Surgeon (Burma Service), Devaraya-samudram Post, Via Kolar District, Mysore.
- Iyer**, V. Rama, B.Sc.Met., A.I.M. M.I.I.M., Metallurgist, M/s. Bhartia Electric & Steel Co. Ltd., 8, Swinhoe Street, Calcutta 19.

J

- Jacob**, K., D.Sc., F.G.S., F.N.I. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Jacob**, K.T., M.A., Ph.D., Head of the Dept. of Botany, Bose Institute, 93, Upper Circular Road, Calcutta.
- Jadhab**, Ganpatrao Vishramrao, B.A., (Hons.), M.Sc., Ph.D., A.I.C4, Professor of Organic Chemistry, Institute of Science, Mayo Road, Bombay.

- Jain, A. P.**, Msc., Lecturer in Geology, Patna University, Patna.
- Jain, Motilal**, D.Sc., M.E.E., & Prof. of Electrical Engineering, College of Engineering and Technology, Jadavpur, Calcutta 32.
- Jain, M.S.**, M.Sc., Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Jalota, S.**, M.A., D.Phil., Professor of Psychology, Benares Hindu University, Benares.
- James, H. D. K.**, B.Sc., A.M.I.E., Engineer, Technical Department, Standard Vacuum Oil Co., 6, Church Lane, Calcutta.
- Jatkar, S. K. K.**, D.Sc., F.I.Sc., F.I.C., F.Inst.P., Department of Pure and Applied Chemistry, Indian Institute of Science, Malleswaram, P.O. Bangalore.
- Jay Engineering Works**, 183A, Prince Anwar Shah Road, Dhakuria—Post., Calcutta 13.
- Jennings, B. R.**, Professor of Dentistry, Medical College Hospital, 39, Chowringhee Road, Calcutta 16.
- Jhingran, Anant Gopal**, M.Sc., (Benares), Ph.D., (Durham), Geologist, Geological Survey of India, 27, Chowringhee, Calcutta.
- Jnanananda, (Dr.)**, Swami, National Physical Laboratories, University Buildings, New Delhi.
- Job, T.J.**, D.Sc., F.N.I., F.Z.S.I., F.R.A.S.B., Asstt. Regional Fisheries Representation For Asia and Far East, R. A. O. Building, Bangkok.
- Johri, B. M.**, D.Sc., Lecturer, Dept. of Botany, University of Delhi, Delhi.
- Jois, H. Subba**, M.Sc., Professor of Organic Chemistry, Central College, Bangalore.
- Jolly, (Mrs.)**, Shugh, C/o. Technical Director, Instruments & Chemicals Ltd., Ambala Cantt.
- Jolly, A. P.**, Instruments & Chemicals Ltd., Ambala Cantt..
- Jones, S.**, M.Sc., Research Officer, (Estuarine) Central Inland Fisheries Research Station, Barrackpore, 24 Parganas.
- Joshi, A. C.** D.Sc., F.N.I., Principal Government Training College, for Techno. Jullunder.
- *Joshi, B. B.**, L.T.M., (Hons.), A.T.I., (Manch.), Textile Technologist, Directors of New India Industries Ltd., Engineering & Agencies Ltd., Textile Stores (Baroda) Ltd., 81, Alkapuri, Baroda.
- Joshi, C. B.**, M.A., Nowrosjee Wadia College, Poona 2.
- Joshi, Krishna Chandra**, M.Sc., Lecturer Department of Chemistry, University of Lucknow, Lucknow.
- Joshi, N. S.**, Rao Bahadur, B.E., (Civil), M.I.E., (India) M.R.San.I., (Lond.), Retd. Superintending Engineer, (Bombay P. W. D.), 1287, Shivaji Nagar, Poona 5.
- Joshi, N. V.**, B.A., M.Sc., L.Ag., Maharashtra Association for Cultivation of Science. Law College Building, Poona 4.
- Joshi, P. N.**, M.Sc., (Tech.), Principal and Secretary, Victoria Jubilee Technical Institute, Matunga, Bombay.
- Joshi, S. S.**, M.Sc., (Lond.), University Professor and Head of the Department of Chemistry and Principal, College of Science, Benares Hindu University, Benares.

K

- Kalamkar, Dr. R. J.**, Director of Agriculture, Madhya Pradesh, Nagpur.
- *Kalapesi, A. S.**, B.A., B.Sc., D.I.C., Ph.D. (Lond.), F.G.S. F.R.G.S., Professor and Head of the Department of Geology and Geography, St. Xavier's College, Cruickshank Road, Bombay 1.

- Kalyansundaram, V., M.A., L.T.,** Asst. Director, India Bureau of Mines, Ministry of Works, Mines & Powers, Central Secretariat, New Delhi.
- Kamat, V. V.,** Indian Institute of Education, 11, Elphinstone Circle, Bombay.
- Kane, Govind Pandurang, M.Sc., Ph.D. (London), D.I.C.,** Department of Chemical Technology, Bombay University, Matunga Road, Bombay 19.
- Kanga, D. D., I.E.S. (Retd.),** The Theosophical Society, Adyar, Madras.
- Kanjilal, A. K.,** Electrical Engineer, C.P.W.D., 14, Madan Street, Calcutta.
- Kanoria, Gopi Krishna,** Merchant and Banker, Post Box No. 7, Chowk, Patna City.
- Kapoor, L. D.,** Chif Botanist, Drug Research Laboratory, Jammu Tiwi Kashmir.
- Kapoor, R. C., M.Sc., D.Phil., F.N.A.Sc.,** Dept. of Chemistry, University of Allahabad, Allahabad.
- Kapur, (Dr.) A. P.,** Entomologist, Indian Lac Research Institute, Namkum, Ranchi.
- Kapur, P. L.** Department of Physics, University of Delhi, Delhi.
- Kappanna, A. N., D.Sc.,** College of Science, Nagpur (C.P.).
- Kapadnis, D.G. M.Sc.,** National Physical Laboratory Hill Side Road, New Delhi 5.
- Kar, Dr. A. B., M.Sc., Ph.D. (Edin.), F.P.Sc.A., (U.S.A.),** Central Drugs Laboratory, 110, Chittaranjan Avenue, Calcutta 12.
- Kar, Asok Kumar, M.Sc.,** Rice Research Officer, Bankura, B. N. Rly.
- Kar, Dr. B. K., M.Sc., Ph.D., F.B.S.,** Jute Agricultural Research Institute, Lalkoti, Barrakpur Home Add : 39/1, Padda Pukur Road, Calcutta 20.
- Kargaokar, M.N., M.A.,** Professor and head of Mathematics Dept., M. N. College, Visnagar.
- Karmakar, D. V., M.Sc., Ph.D., A.I.I.Sc.,** Technical Adviser, Ministry of Food & Agriculture, Jamnagar House, Man Singh Road, New Delhi.
- Karmakar, J., C.E., A.M.A.E.,** Construction Engineer, Buildings & Roads, Nepanagar P.O., Nimar-Dist., Madhya Pradesh.
- Karunakaran, C., M.Sc.,** Geologist, Geological Survey of India, Muli Uttara (C.S.) Rajot (Saurashtra).
- Karve, D. D., M.Sc., Ph.D., A.I.I.Sc.,** Principal and Professor of Chemistry, Fergusson College, Poona 4.
- Karve, (Mrs.) Irawati, M.A., Ph.D.,** Reader in Sociology, Deccan College, Poona 1.
- Kasaven, B. S., M.A., Dip. Lit.,** Librarian, National Library, Calcutta.
- Kasthuri, A. K., B.Sc. (Hon.),** Asst. Professor of Geology, Presidency College, Triplicane, Madras 5. Home Add: Meher Bhawan, 20, Brahmin Street, Madras 15.
- Katti, M. C. Tummin, M.Sc., Ph.D.,** Chief Chemist & Works Manager, Karnatak Chemical Works, Gadag, M. & S. M. Rly.
- Katre, S.M.,** Director, Deccan College, Post Graduate & Research Institute, Poona 1.
- Kaul, K. N. F.L.S.,** Honorary Director, National Botanical Garden, and Prof. of Botany, Govt. Agricultural College, Kanpur.
- Kehar, N. D., M.Sc., Sc.D.,** Officer-in-Charge, Animal Nutrition Section, Indian Veterinary Research Institute, Izatnagar (U.P.).
- Kelkar, K. V.,** Prof. of Geology No. 6, Ferguson College, Poona 4.
- Khambata, F.S., B.Ag., M.Sc., B.G.V.C.,** C/o. Mrs. Gazdar Family Advise, 794, Parsi College, Dadar, Bombay 14.
- Khan, Hamid Ahmed, M.Sc.,** Research Scholar, Central Laboratory for Scientific and Industrial Research, Hyderabad, Deccan.
- Khan, Reayat,** Botany Department, Aligarh University, Aligarh.
- Khan, Mohd. Naser, M.A.,** 5A, Beli Road, New Katra, Allahabad.
- Khanna, K. L., B.Sc., (Agri.), Assoc. I.A.R.I., F.A.Sc.,** Director, Sugarcane Research of Development, Pusa, (O. T. Ry.).

- Khanolkar**, Dr. V. R., B.Sc., M.D. (Lond.), Director, Indian Cancer Research Institute Centre, Tata Memorial Hospital, Parel, Bombay 12.
- Khara**, B. R., A.M.I.B.E., A.I.S.E., Deputy Commandant, Royal Indian Engineers, Head Quarters, Poona-Sub-Area, Poona.
- Khastgir**, S. R., D.Sc., F.N.I., M.I.R.E., Head of the Department of Physics, Benares Hindu University, Benares.
- Khidkar**, V. R. R., Geological Survey of India 27, Chowringhee, Calcutta 13.
- Khorana**, M. L., B.S., (Pharm.), M.S. (Mich.), Indian Journal of Pharmacy, Dept. of Chemical Technology, Matunga, Bombay 19.
- Khosla** Ajudhia Nath, Rai Bahadur, I.S.E., Consulting Engineer for Waterways, Irrigation & Navigation, and Chairman Central Secretariat, New Delhi.
- Khundkar**, Dr. M. A., Chemical Laboratory, Dacca University, Ramna P.O., Dacca.
- Kichlu** Dr. P. K., Professor of Physics, Dept. of Physics, Delhi University, Delhi.
- Kilpady** Sripada, M.Sc., F.G.S., Head of the Department of Geology, Nagpur University, Nagpur.
- Kishin**, K., Statistician, Department of Agriculture, United Provinces, Lucknow.
- Kishore**, Raj, M.Sc., Professor of Physics, Government College, Ajmer.
- ***Kishore**, Ram, B.A., A.M.I.E. (Ind.), Asst. Engineer, Irrigation Office, Cantonment Road, Lucknow, U. P. Home: 1, Sunderbagh, Lucknow.
- Kochar**, B.D., D.Sc., F.R.I.C., Glancy Medical College, Amritsar.
- Kogekar**, N. V., M.Sc., 178, Radha Niwas, Balchandra Road, Hindu Colony, Dadar, Bombay 14.
- Kolhatkar**, G.B., M.A., A.I.I.Sc., (Kholatkar's Bungalow) Near M.E.S. College, Deccan Gymkhana, Poona 4.
- ***Kosambi**, D. D., D.Sc., Tata Institute of Fundamental Research, 53, Poddar Rd., Bombay; 26, Apollo Pier Road., Bombay 21.
- Kothare**, A. N., Professor Chemistry Department, St. Xavier's College, Cruickshank Road, Bombay 1.
- Kothari**, D. S., D.Sc., Ph.D., F.N.I., Scientific Adviser, Ministry of Defence, South Block, New Delhi.
- Kothari**, H. C., Statistical Officer, Jaipur State, Jaipur.
- Kripalini**, (Miss) M. B., Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta.
- Krishnamurthy**, D. V. G., B.Sc., B.A.S., M.S., Publicity Officer, Dept. of Agriculture, Hyderaguda, Hyderabad (Deccan).
- Krishnan**, Dr. Sir K. S., F.R.S., Director, National Physical Laboratory, Hillside Road, Delhi.
- ***Krishnan**, M. S., M.A., Ph.D., A.R.C.S., D.I.C., F.N.I., Geologist, Geological Survey of India, 27, Chowringhee, Calcutta.
- Krishnan**, Dr. R. S., D.Sc., Ph.D. Dept. of Physics, Indian Institute of Science, Malles-Warm P. O. Bangalore.
- Krishnan**, Dr. S. V., Anatha, Professor of Chemistry, Madras Christian College, Tambaram, South India.
- Krishnaswami**, K. R., D.Sc., (Lond.), Industrial Chemist to Government of Bihar, Secretariat, Patna.
- Krishnaswamy**, V. D., M.A., Dip. Arch. (Cantab.), Dept. of Superintendent Archaeology, South Eastern Circle, Peta P. O. Vizagapatam Dist.
- Kulkarni**, G. S., M.Ag., Station Road, Dharwar.
- Kulkarny**, H. L., M.Sc., Balkrishna Ashram, Bhandarkar Institute Road, Poona 4.
- Kumar**, B.K., B.E.E., Asst. Electrical Engineer, C.P.W.D., Calcutta Air Port, Dum Dum, 28, Mohendra Sircar Street, Calcutta 12.
- Kumar**, G.D., M.Sc., Research Associate, Department of Anthropology, Government of India, Indian Museum, Calcutta.

- Kumar, Jasoda**, M.Sc., Psychologist, C/o. Biological Supply Concern, 5A Kali Dutta Street, Calcutta—5.
- Kumar, L.S.S.**, Economic Botanist to Government, B.P., Poona 5.
- Kundu, Anil**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Kundu, B.C.**, M.A., Ph. D. (Leeds), F.L.S. (Lond.), F.N.I., Director, Jute Agricultural Research Institute, Hooghly.
- Kundu, Gobinda Kishore**, B.A., B.T., Teacher, A. V. School, Shyambazar, Calcutta.
- Kundu, Jnan Ranjan**, B.Sc. (Eng.), Engineer, Electrical Division, Moore Canal Project, Suri P.O., Birbhum.
- Kuppuswamy, B.**, M.A., D.Litt., Lecturer in Psychology, University of Mysore, V. V. Mohalla P.O., Mysore.
- Kuriyan, George K.**, Research Assistant, Marine Biological Station, Krushadai Island Pamban, P.O., Ramnad District.
- Kuriyan, (Dr.) George**, B.A., Ph.D., B.Sc., Professor of Geography, University of Madras.
- Kutar, P.H.**, B.A., B.Sc., (Hons.), Met.E. (Edin), General Manager, Tata Iron & Steel Co., Ltd., Jamshedpur.

L

- Lacy, R.C.**, D.Sc., Head of the Department of Botany, Science College, Patna 5.
- Lahiri, Dr. A.**, Asst. Director, Fuel Research Institute, Digwadi, P.O., Jealgora, Dist. Manbhum.
- Lahiri, Bhupendra Nath**, Sub-divisional Officer, Mechanical & Transport Sub-Division, P.O., Hastings, Kidderpore Bridge Approach, Calcutta.
- Lahiri, D.C.**, M.B. (Cal.), Ph.D. (Bom.), Dip.Bact. (Lond.), D.T.M. & H. (Eng.), Asst. Director, 1/C, Dept. of Antitoxins & Sera, Haffkine Institute, Parel, Bombay 12.
- Lahiri, Durga Das**, M.Sc., Ph.D. (Sheffield), Lecturer Department of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Lahiri, (Dr.) M.N.**, Associated Professor of Microbiology, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Lakshmanan, C.K.**, Lt.Col., L.M.S. (Mad.), M.R.C.S., D.T.M. & H. (Lond.), D.P.H. (Eng.) Director, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Lakshmipathy, B. M.**, M.E., M.R.A.S.E., Joint Director of Agriculture, "Rushkyrum" Mount Road, Madras.
- Lakshmi Perfume Co.**, 1, Meherali Mondal Street, Calcutta 27.
- Lakhanpal, R.N.**, Birbal Salim Institute of Palaeobotany, University Road, Lucknow. U. P.
- Lal, Dr. D.N.**, Head of the Statistics Department, University of Patna.
- Lal, Dr. J.B.**, H.B. Technological Institute, Nawabganj, Kanpur.
- Lal, K. B.**, M.Sc., Ph.D., (Edin.), Entomologist to Govt., U. P., Kanpur.
- Lal, Dr. M. B.**, Reader in Zoology, Lucknow University, Lucknow.
- Lal, Ram Bihari**, M.B.B.S., D.P.H., D.T.M. & H., D.B., F.N.I., Professor Epidemiology and Vital Statistics, All-India Institute of Hygiene and Public Health, 110, Chittaranjan Avenue, Calcutta.
- Lalitha, (Miss) K. R.**, B.Sc., Indian Dairy Research Institute, Bangalore.
- Laul, (Miss) K. S.**, M.Sc., Nagpur University Research Fellow, University Department of Biochemistry, Nagpur.

Law, Nirmal Chandra, M.Sc., D.Phil., 50, Kailas Bose Street, Calcutta.

Law, Satya Churn, M.A., B.L., Ph.D., F.Z.S., F.N.I., M.B.O.U., 50, Kailas Bose Street, Calcutta.

Lawande, Y. V., Professor, Chemistry Department, St. Xaivers College, Cruickshank Road, Bombay 1.

Limaye, S. D., Ph.D., Director, The Rasayana Mandira, Kapilashrama, Navi Peth, 128, Sadashib, Poona 2.

Loomba, Ramnurti, Lecturer in Philosophy, Lucknow University, Lucknow.

Luthra, S. P., B.Sc., (Engg.), Ph.D. (Lond.), D.I.C. (Chem.Engg.) (Lond.), Head of the Engineering Department, Government of India Polytechnic, Kashmere Gate, Delhi.

Luthra, Jai Chand, Rai Bahadur, I.A.S., C/o. Dr. R. S. Vasudevay, 14, Agricultural Research Institute, New Delhi.

M

M. F. Sugar Mills Co. Ltd., Manager, P. O. Majhanlia, R. S. Champaran.

Macmillan, William George, Ph.D. (Cantab.), F.I.C., Chief Chemist, Indian Jute Mills Association, Research Institute, 16, Old Court House Street, Calcutta.

Madhok, M. R., Ph.D., I.A.R.I., P.A.S., (1), State Biochemist & Agricultural Bacteriologist, Punjab, Ludhiana.

Maga, N. G., M.Sc., Ph.D., Biochemistry Department, Institutet of Science, Fort, Bombay.

Mahabale, T. S., M.A., M.Sc., Ph.D., F.N.I., F.A.Sc., Assistant, Dictionary of Economic Product and Resourcees of India, Council of Scientific and Industrial Research, 20, Pussa Road, Karolbagh, New Delhi.

Mahadevan, C., M.A., D.Sc., F.A.Sc., F.N.A.C., F.M.G.S., F.N.I., Head of the Department of Geology, Andhra University, Erskine College of Natural Sciences, Waltair.

Mahajan, L. D., M.Sc., Ph.D. F.Inst.P., (Lond.), Professor and Head of the Physics Department, Mahendra College, Patiala (State), Director of Met. Observation, Pepsu, Patiala.

Mahajani, A. V., M.Sc., Lecturer in Chemistry, University of Saugar, Saugar, M.P.

Mahal, H. S., Office of the Analyser, Government Laboratories, Byculia, Bombay.

Mahalanobis, P. C. M.A., B.Sc., F.N.I., O.B.E., F.R.S., Statistical Laboratory, Presidency College, Calcutta.

Mahalanobis, Rabindra Chandra, Engineering Overseer, Calcutta Corporation, 18A, Kanai Dhar Lane, Calcutta 12.

Mahalanobis, S. K., 90, Park Street, Calcutta 16.

Maharastra Sugar Mills Ltd., The, Industrial Assurnce Building, Opposite Churchgate Station, Fort, Bombay.

Mahendra, Beni Charan, D.Sc., F.Z.S., F.A.Sc., Professor Zoology, Agra College Agra.

Maheswari, Panchanan, D.Sc., F.N.I., Professor of Botany, Delhi University, Delhi.

Maiti, Haripada, M.A., Professor and Director of Applied Psychology, Patna University, Patna.

Maitra, B., M.Sc., F.C.S., Director, Calcutta Chemical Co. Ltd., 35, Panditia Road, Calcutta.

Maitra, Dr. J. N., M.Sc., M.B., D.T.M., D.P.M. (Cal.), 1, Corries Church Lane, Amherst Street P. O., Calcutta.

- Maitra**, Susil Ranjan, Department of Physiology University College of Science
92, Upper Circular Road, Calcutta 9.
- Majumdar**, B. B., M.B., Asst. Professor of Physiology, Medical College, Calcutta.
- Majumdar**, Benoy Kumar, D.F.H., A.M.I.E.E., Executive Engineer, Central Public
Work Dept., 19, Sarat Chatterjee Avenue, Calcutta 29.
- Majumdar**, D. N., M.A., P.R.S. (Cal.), Ph.D. (Cantab.), F.R.A.I., F.N.I., Professor
of Anthropology, Lucknow University, Lucknow.
- Majumdar**, Dr. G. G., M.Sc., Ph.D., 187, Kesaba Peth, Poona 2.
- Majumdar**, Girija Prasanna, M.Sc., Ph.D., F.N.I., 19, Ekdalia Place, Calcutta 29.
- Majumdar**, J. N., M.B., L.R.C.P., M.R.C.S. etc., Medical Practitioner, 3, Chowringhee
Square, Calcutta.
- Majumdar**, R. C., M.Sc., Dr. Phil-Nat., Asso. Professor, of Physics, Delhi University
Delhi.
- Majumdar**, Subodh Kumar, M.Sc., Ph.D., Principal, Darjeeling Government College,
Darjeeling.
- Malakar**, M.C., Dr. Sc. (Paris), Asst. Research Officer, Indian Council of Medical
Research, 92, Upper Circular Road, Calcutta 9.
- Malhotra**, D. R., D.Sc., F.N.I., M.I.Chem., E.F.I.M., M.I.E., Chief Chemist and
Metallurgist, B. B. & C. I. Rly., Ajmer.
- Mallik**, A. K., M.Sc., Meteorologist, Meteorological Office, Poona, 5.
- Mallik**, N. C., A.M.M.E.; Foreman, Template & Jog Shop, Structural Department,
Burn & Co. Ltd., Howrah, 100E, Taltola Lane, Calcutta 14.
- Mallik**, P. C., Fruit Research Station, Sabour (Bhagalpore).
- Mallya**, Lt. Col., B.G., I.M.S. (Retd.), 2, Minto Road, Calcutta.
- Managing Agents**, The Associated Instrument Mnfrs. (India), Ltd., Calcutta.
- Mandal**, Benoy, B.Sc., (Wales), C.D.D. (Aberystwyth), P. O. Jadavpur College,
Calcutta 32.
- Mandal**, S. C., Agricultural, Chemistry Section, Fruit Research Station, Sabour
(Bhagalpore).
- Mandan**, Sahib Ram, M.A., Dayal Singh College, Karnal, (E. Punjab).
- Mangalik**, Vanmali Sharan, M.D., D.C.P. (London.), Reader in Pathology, King
George's Medical College, Lucknow.
- Mani**, M. S., M.A., D.Sc., F.Z.S., Professor of Zoology, St. Johns College, Agra.
- Mankad**, B. N., B.S., Ph.D., Professor of Chemistry, Vithalbhai Patel Mahavidyalaya,
Vallabh Vidyanagar, Anand.
- Manna**, Gobind Kishor, Lecturer in Zoology, Bangabasi College, Scott Lane,
Calcutta.
- Mansingh**, Bishan, B.A., Zaminder and Farmer, The Man Bhavan, Fathpur, U.P.
- Masani**, Narman Adarji, M.A., B.Sc., Technical Chemist, Petit Mansion, Sleater
Road, Bombay, 7.
- Mathew**, N. T., M.A., M.Sc., Chief Statistical Officer, Army, 13, Mandi House, Lytton
Road, New Delhi.
- Mathrani**, H. P. O.B.E., I.S.E., M.I.E., M.Sc., (Edin.), 31, Aurangeb Road, New Delhi 2.
- Mathur**, G. D., M.A., M.Sc., Statistical Research Officer, Office of the Economic
Adviser, Government of India, New Delhi.
- Mathur**, (Capt.) Har Govind Dayal, M.B., M.R.C.P.E., Dr., P.H., Secretary, Medical
Council of India, Connaught Circus, New Delhi.
- Mathur**, K. N., D.Sc., Assistant Director, National Physical Laboratory of India,
1, Hillside Road, New Delhi.
- Mathur**, R. N., M.Sc., Ph.D., Systematic Entomologis Forest Research Institute,
Dehra Dun.
- Mathur**, S.B.L., Physics Dept. Lucknow University, Lucknow.

- Mathur, S. M.**, M.Sc., F.G.M.S., A.M.G.I., Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Mathur, S. N.**, M.B.B.S., Ph.D. (Lond.), Professor of Physiology, Medical College, Lucknow.
- Matthai, Abraham**, Indian Statistical Institute, 87, Barrackpore Trunk Road, P. O. Alambazar 24-Parganas.
- Mazumder, Arbinda**, M.Sc., Bengal Immunity Co. Ltd., Baranagar P. O., 24 Parganas.
- Mazumder, Bibhuti Bhusan**, Lecturer in Mechanical Engineering, M. E. Dept., C.I.T., Bengal, Bengal, Jadavpur College P.O., Calcutta 32.
- Mazumdar, K. C.**, The New Control Research Laboratory, Tata Iron & Steel Co. Ltd., P. O. Tatanagar, B. N. Ry.
- McBain, James W.**, M.A., Ph.D., D.Sc., F.R.I.C., F.R.S., Director, National Chemical Laboratory of India, Poona 5.
- McFarland, Francis**, Head of the Department of Physics, Loyola, Jamshedpur.
- Mechanical, Engineers Association (India)**, 63, Ferguson Road, Lower Parel, Bombay 13.
- Mehra, Bal Krishan**, M.Sc. (Tech), M.Sc., (Pharm), F.A.F.P.E. (Ny. Yourk), Technical Representative, Chans. Pfizer & Co. Incorporated New York, C/o. Dey's Medical Stores, 6/2B, Lindsay Street, Calcutta 16.
- Mehra, H. R.**, M.Sc., Ph.D., (Cantab), Prof. of Zoology, Allahabad University, Allahabad; 33, Chatham Lines, Allahabad.
- Mehra, P. N.**, D.Sc., Head of the Dept. of Botany, East Punjab University, Khalsa College, Amritsar.
- Mehra, R. K.** M.Sc., Central College of Agriculture, Anand Parbat, Karol Bagh, New Delhi.
- Mehrotra, H. N.**, M.Sc., Asst. & Technical Officer, I.C.I. (India), Ltd., 18, Strand Road, Calcutta.
- Mehta, B. N.**, M.Sc., A.H.B.T.I., Public Health Chemist, Pratapganj, Baroda.
- Mehta, C. R.**, M.Sc., Ph.D., Prof. of Pharmaceutical Chemistry, L. M. College of Pharmacy, Ahmedabad.
- Mehta, D. R.**, Research Chemist, Alembic Chemical Works Co. Ltd., Baroda.
- Mehta, G. K.**, Diwan House, Jodhpur, Marwar.
- Mehta, Dr. I. H.**, Dy. Vice-Principal, Govt., Polytechnic, Kashmeregate, Delhi.
- Mehta, Jivraj Narayan**, M.D. (Lond.), M.R.C.P., (Lond.), L.M. & S. (Bom.), F.C.P.S. (Bom.), Physician, Khambutta Hall, 16, Altamont Road, Cumbulla Hill, Bombay 26.
- Mehta, K. M.**, M.Sc., Assoc.I.A.R.I., Public Analyst, Public Health Department, Jodhpur.
- Mehta, (Miss) Maneck M.**, M.A., M.Sc., (Bom.), D.Sc., Ph.D., (Lond.), F.I.C., D.I.C., Khambatta House, Young Ladies' High School, Stafford House, 33, Murzban Road, Fort, Bombay.
- Mehta, P. D.**, Hindustan Construction Co. Ltd., Shananagar P. O., 24 Parganas.
- Mehta, P. L.**, C/o. Minerva Dyes & Chemicals Co., Inside Khanstate, Opp. Pandi Dharmshala, 262, Thakurdwar Road, Bombay 2.
- Mehta, R. R.**, C/o. Technical Director, Instruments & Chemicals Ltd., Ambala Cant.
- Mehta, S.M.**, B.A., M.Sc., A.I.C., Lecturer in Inorganic Chemistry, The Institute of Science, Mayo Road, Bombay.
- Mehta, Dr. T. N.**, Reader Laxminarayan Institute of Technology, Amaravati Road, Nagpur.
- Menon, K. K.**, Senior Research Officer, Durron of Mineral Survey of Research, Travancore University, Trivandrum.
- Menon, K. P.**, L.R.C.P. & S. (Edin.), 1, Viviani Road, Richards Town, Bangalore 5.

- Menon**, P. Balarama, Asst. Research Officer, Section of Parasitology, Indian Veterinary Research Institute, Izatnagar.
- Menon**, T.K.N., B.A., T.D. (Leeds & Berlin), M.A.Ed. (Leeds), Principal, Secondary Teachers' Training College, Editor, Journal of Education and Psychology, Sayaj-ganj, Baroda.
- *Metre**, W. B., Geologist, B. O. C. (I. C.) Ltd.; P. O. Digboi, Assam.
- Mishra**, Brahmananda, Professor of Physics, Ravenshaw College, Cuttack 3.
- Misra**, A. B., D.Sc., D.Phil., Head of the department of Zoology, Benares Hindu University, Benares.
- Misra**, D., M.Sc., Head of the Chemistry Dept., Govt. College, Sambalpur.
- Misra**, M.L., M.A., D.Sc., Reader in mathematics, University of Saugar, Saugar, (M.P.)
- Misra**, R. A. P., Indian Wild-Barfield Co., Ltd., Fort Chambers, 6/10, Dean Lane, Hammam Street, Fort, Bombay.
- Misra**, R. C., M.Sc., F.G.M.S., Ph.D., Department of Geology and Botany, Lucknow University, Lucknow.
- *Misra**, Dr. Ramadhar, M.A., Ph.D., (Edin.), Reader in Mathematics, Lucknow University, Lucknow.
- *Misra**, Ramdeo, M.Sc., Ph.D., (Lond.), Reader and Head of the Botany Department, University of Saugar, Saugar, C. P.
- Mistry**, S. M. M.Sc., A.I.I.Sc., 84, Sion Road, Sion, Bombay 22.
- Mitra**, (Miss), Abha, Prof. of Mathematics, Patna Women's College, Patna.
- Mitra**, A. C., Managing Director, M/s. International Tyres & Motors Ltd., 2, Rowland Road, Calcutta.
- Mitra**, Dr. A. K., Ph.D., Lecturer in Botany, University of Allahabad, 22, K. P. Kakkar Road, Allahabad.
- Mitra**, Birendra Kumar, M.Sc., F.Z.S. (Lond.), Prof. of Biology, Central Calcutta College, 8, Wellesly Street, Calcutta.
- Mitra**, B. N., Manager, Agriculture Machinery Manufacturing Corpn. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Mitra**, C. R., Agricultural Machinery Manufacturing Corpn. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Mitra**, G. C., M.Sc., D.Phil., Department of Botany, University of Delhi, Delhi 8.
- Mitra**, G., M.Sc., Indian Association for the Cultivation of Science, Jadavpur, Calcutta 32.
- Mitra**, Himansu K., M.Sc. (Cal.), Ph.D. (Pittsburg), M.I.Cer.E. (U.S.A.), F.N.I., Refractories Engineer, Tata Iron & Steel Co., Ltd., 12-A, Road East, Jamshedpur.
- Mitra**, Kalidas, M.B.E., M.B., D.P.H. (Cal.), D.T.M. & H. (Eng.), F.S.S. (Lond.) F.N.I., Office of the Director-General of Health Services, Central Government, New Delhi.
- Mitra**, (Miss.) Eva, M.A., Research Asst. (Selection Grade), 14, Chowringhee Terrace, Calcutta.
- Mitra**, H. R., Hospital Assistant, Silanibari Tea Estate, North Lakhimpur, P. O., Assam.
- Mitra**, Manindra Nath, M.Sc., Bengal Immunity Co. Ltd., Baranagar P. O., 24-Pargonas.
- Mitra**, Ram Prasad, D.Sc., Department of Chemistry, Delhi University, Delhi.
- Mitra**, S. K., A.M.Ch.E., M.A.E., M.I.I.-Chem.E., Suite No. 8, 26, Chowringhee, Calcutta 13.
- Mitra**, S. K., D.Sc., F.N.I., Sir Rashbehary Ghosh Prof. of Physics, Dept. of Radio Physics & Electronics, University College of Science, 92, Upper Circular Road, Calcutta.

- Mitra**, S. K., Rai Bahadur, M.Sc., Ph.D., I.A.S. (Retd.), P509, Aswani Dutta Road, P.O. Rash Behari Avenue, Calcutta 29.
- Mitra**, Suhrit Chandra, M.A. (Cal.), Dr., Phil (Leipzig), Head of the Psychology Department, University College of Science, 92, Upper Circular Road, Calcutta.
- Mitra**, S. N., M.Sc., (Lond.), D.I.C., F.R.I.C., Public Analyst, Public Health Laboratory, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Mitra**, S. P. M.Sc., D.Phil., F.N.A.Sc., Lecturer in Chemistry, Sheila Dhar Institute of Soil Science, University of Allahabad, Allahabad.
- Mitra**, S. R., Agricultural Machinery Manufacturing Corp'n. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Mitter**, A., M.Sc., (Cal.), Geological Survey of India, 27, Chowringhee, Calcutta.
- Mitter**, Anadi Kumar, 30/1, Radhamadhav Dutta Garden Lane, Calcutta.
- Mitter**, G. C., O.B.E., M.Sc., F.R.I.C., F.N.I., Chief Technical Adviser (Mints), Bombay.
- Mitter**, P. C., M.A., Ph.D., F.N.I., Palit Professor & Head of the Dept. of Pure Chemistry, Calcutta University, University College of Science, 92, Upper Circular Road, Calcutta.
- Modok**, Bidhu, C/o. Agricultural Machinery Manufacturing Corp'n. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Modak**, N. V., B.E., M.I.C.E., M.I.E. (Ind.), M.I.M. & Cy., E.F.R.San.I., Ac. J. P., City Engineer, Bombay Municipality, Udayan, Shivaji Park, Bombay 28.
- Modi**, D. F., B.Sc., Head of the Electrical Department, William Jacks & Co. Ltd., 16, Netaji Subhas Road, Calcutta.
- Mody**, G. S., M.B.B.S., Anatomist, Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta 13.
- Moghe**, Krishnaji Shankar, Mahilashram, Hingane, Poona 4.
- Moghe**, Dr. M. A., M.A., M.Sc., Ph.D., (Lond.), Head of the Department of Zoology, College of Science, Nagpur.
- Mohsin**, S. M., M.A., Ph.D. (Edin), Department of Psychology, Patna College, Patna.
- Mookerjee**, M. C., B.Sc., Engg., A.M.I.E., Chartered Engineer, Maintenance Superintendent, M/S. Alkali & Chemical Corporation of India Ltd., Rishra P.O., Hooghly, West Bengal.
- Mookerjee**, Dr. Freda Celestine, Lecturer in Anthropology, University of Delhi, Delhi.
- Mookerjee**, Himadri Kumar, M.Sc. (Cal.), D.I.C., D.Sc. (Lond.), F.N.I., Sir Nilratan Sircar Professor and Head of the Dept. of Zoology, Calcutta University; 27, Kailash Bose St., Calcutta.
- Mookerjee**, H. K., Professor of Zoology, University College of Science 35, Ballyganj Circular Road, Calcutta.
- Mookerjee**, K. C., M.Sc., Inter-Provincial Mental Hospital, Ranchi.
- Mookerjee**, Piyushansu Sekhar, M.Sc., Lecturer in Zoology, Surendra Nath College, 24, Harrison Road, Calcutta 9.
- Mookerjee**, R. P., M.A., B.L., Judge, High Court; 77, Ashutosh Mookerjee Road, Bhowanipore, Calcutta.
- Mookerjee**, Sitanshu, M.A., Head of the Department of Geography, Nagpur University, Morris College, Nagpur.
- Mookerjee**, Sivatosh, M.Sc., Ph.D., College Research Unit, Chittaranjan Cancer Hospital, Russa Road, Calcutta 26.
- Moudgill**, Kishori Lal, M.A. (Cantab), D.Sc., F.I.C., Deputy Director (Chemicals), Indian Standards Institute, 19, University Road, Delhi 2.
- Mudaliar**, C. Rajasekhara, Agricultural College, Lawbay Road, Coimbatore.
- Mookerjee**, Sunil Kumar, D.Sc., (Cal.), Lecturer in Botany, Delhi University, Delhi.

- Mukerjee**, Sudhansu Kumar, M.Sc., Research Worker, Section of Microbiology, Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Mukerjee**, S., M.Sc., Ph.D. (Cantab), A.R.I.C., A.I.I.Sc., Asst. Professor of Sugar Chemistry, Indian Institute of Sugar Technology, Kanpur.
- Mukerjee**, Umadas, M.Sc., Professor and Head of the Department of Physics, College of Science, Nagpur.
- Mukherji**, Amal Kumar, M.A., B.Sc., B.Com., 12, Mission Row, Calcutta.
- Mukerji**, M., M.D., D.Sc., F.A.Ph.S., F.N.I., Offg. Director, Central Drugs Research Institute Government of India, Chattrar Kazil Palace, Lucknow.
- Mukerji**, D.K., Dept. of Textile Industries, The University Leeds 2, England.
- Mokerji**, Durgadas, M.Sc., Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Mukerji**, (Dr.) H. N. M.Sc., Ph.D. (Lond.), D.I.C., Agricultural Chemist to Govt. of Bihar Sabour, P. O., Bhagalpore.
- Mukerji**, N., Reader in Education, Gauhati University, Gauhati (Assam).
- Mukerji**, (Mrs.) Rani, M.Sc., C/o. A. K. Mukerji, Esqr., 12, Mission Row, Calcutta.
- Mukherjee**, Amal Krishna, Professor of Biology, Presidency College, Calcutta.
- Mukherjee**, Asoke Kumar, M.Sc., Physical Chemistry Laboratory, College of Engineering & Technology, Jadavpur, Calcutta 32.
- Mukherjee**, Abani Ranjan, 27, Nabakumar Nandy Bye Lane, Howrah.
- Mukherjee**, A. N., Major, M.Sc., M.B., Superintendent, Mental Hospital, Baroda.
- Mukherjee**, Bankim, M.M.F. (Bengal), L.D.S., R.S. (Eng.), Clinical Dental Tutor, Medical College Hospital, Calcutta.
- Mukherjee**, Dibakar, M.Sc., Chemist-in-Charge, Research Laboratory, Baranagore Jute Factory Co. Ltd., P.O. Alambazar, 24-Parganas.
- Mukherjee**, J. N., D.Sc. (Lond.), F.C.S., F.N.I., F.R.A.S.B., Director, Central Building Research Institute, Roorkee.
- Mukherjee**, Kashinath, Professor of Geology, City College, 25B, Nepal Bhattacharya Ist Lane, Calcutta 26.
- Mukherjee**, M. K., M.Sc., Ph.D., 44, Manicktala Main Road, Calcutta.
- Mukerji**, S. N., West-End Watch Co., 16, Old Court House Street, Calcutta.
- Mukherjee**, R. G., Electrical Executive Engineer, West Bengal, Writers' Building, 34, Ghosh Lane, Calcutta 6.
- Mukherjee**, S. K., M.Sc., B.L., Assistant Superintendent, Hyderabad Geological Survey, Jeera Compound, Secunderabad, Deccan.
- Mukherjee**, S. K., M.Sc., General Manager, Instrument Research Laboratory Ltd., 309, Bowbazar Street, Calcutta 12.
- Mukherjee**, S. N., Sectional Officer C.P.W.D. 14, Madan Street, Calcutta.
- Mukherjee**, S. N., D.Sc., Professor of Physical Chemistry, College of Engineering and Technology, Bengal, P. O. Jadavapur College, 24-Parganas.
- Mukerji**, S. N., (App. Phy. Cal.), D.I.I.Sc., (Elec. Cal.), A.M.I.E., Chartered Engineer, Dy. Director, (Physical) Government Test House, Alipore, Calcutta 27.
- Mukherjee**, Sambhu Nath, "Kedar Bhavan" Bally, P. O., Howrah.
- Mukherjee**, S. S., B.E., District Engineer, B. N. Ry. B. N. Ry. House, Kidderpore, Calcutta.
- Mukherjee**, Sudhamoy, M.S., Quinologist, P. O., Darjeeling.
- Mukherji**, K. C., M.A., 30/6A, Doctor Lane, Calcutta 14.
- Mukherji**, S. P., M.Sc., C/o. The Zandu Pharmaceutical Works Ltd., Gokhale Road, (South), Bombay 14.
- Mukherji**, Samarnath, B.Sc., Asst. in Power Engineering Dept., Indian Iron & Steel Co., Ltd., Hirapur Works, Burnpur (B. N. Ry.).

- Mukherjee**, Asrujit, B.M.E. Mechanical Eng., Moore Project, 16, Sardar Sankar Road, Calcutta 26.
- Mukheerjee**, D. K., Division of Botany, I. A. R. I., New Delhi.
- Mulay**, B. N., M.Sc., Ph.D., F.B.S., Head of the Dept. of Botany C/o. Birla College, Pilani, Jaipur.
- Mullick**, D. N., M.Sc., Ph.D., Animal Nutrition Section, Indian Veterinary Research Institute, Izatnagar, Bareilly (U. P.)
- Mulye**, Bhalchandra D., M.B.B.S., Sakkar Bazar, Indore City, Central India.
- Mundkur**, B. B., M.A., Ph.D., F.N.I., Deputy Director (Plant Division), Directorate of Plant Protection, Ministry of Agriculture, New Delhi.
- Munigaviappa**, M., M.Sc., Research Fellow, Department of Mathematics, Central College, Bangalore.
- Munsi**, Nihar Kumar, M.B. (Cal.), D.O.M.S. (Lond.), 55, Creek Row, Calcutta 14
- Munshi**, S. K., Managing Director, Olimpia Rubber Works, P35, Princep Street, Calcutta.
- Murthy**, C. K. N., B.Sc., (Hons.), B.Sc. (Text.), Ph.D. (Leed.), Head of the Textile Department, Government of India, Delhi Polytechnic, Kashmere Gate, Delhi.
- Murthy**, L. S. Krishna, B.Sc., F.A.Sc., F.G.S., F.G.M.S., Superintendent, Geologist, 3 Jeero, Secunderabad, Deccan.
- Muthuswami**, T. N., M.A., L.T., Professor of Geology, Presidency College, Triplicane, Madras, Residence: Vheema Sena Garden, Mylapore.
- Mysore**, Sugar Company Ltd., The Secretary, Sri Jayachmaraja Wadayar Road, Bangalore City.

N

- Nabar**, G. M., M.Sc. (Tech.), Ph.D. (Manch.), B.A., M.Sc., (Bom.), Department of Chemical Technology, University of Bombay, Matunga Road, Bombay 19.
- Nabar**, J. A., M.Sc., L.L.B., Professor of Chemistry, Wilson College, Bombay 7.
- Nag**, P. L., Professor of Physics, Jaswant College, Jodhpur.
- Nag**, S. D., B.Sc., P-39, Princep Street, Calcutta 13.
- Nag**, S. K., Engineer, United Commercial Service Ltd., P-39, Princep Street, Calcutta 13.
- Nagappa**, Y., M.Sc., C/o. The Burmah Oil Co. (I.C.) Ltd., Pal Office, P.O. Digboi Upper Assam.
- Naidu**, Bhojraj, Central Laboratories for Scientific & Industrial Research, Narayanguda Section, Distillery Compound, Hyderabad-Deccan.
- Nalk**, S., M.Sc., Lecturer in Botany, G. M. College, Utkal University, Sambalpose.
- Nalk**, Y. G., M.Sc., Ph.D., Professor of Physics, Gujrat College, Ahmedabad, 45, Pritamnagar, Ahmedabad 6.
- Nair**, K. R., M.A., M.Sc., Ph.D. (Lond.), Statistician, Forest Research Institute, Dehra Dun, U.P.
- Nair**, P. V., M.Sc., D.Phil. (Oxon.), Professor of Applied Chemistry, Central Research Institute, University of Trivancore, Trivandrum.
- Namjoshi** (Prof.) A. N., R.A., Podar Medical College, Warli, Bombay 18.
- Nandi**, Dinendra Kumar, B.M.E., Mechanical Assistant, C/o. Jessop & Co., Ltd., 63, Netaji Subhas Road, Calcutta 1.
- Nandi**, Dharendra Nath, M.Sc., M.B.B.S., Department of Physiology, Sir Nilratan Sarkar Medical College, 16, Narendra Sen Square, Calcutta 9.
- Nandi**, H.K., M.Sc., Ph.D., Director of Agriculture, West Bengal, Writer's Building, Calcutta.

- Nandi, Hari Kinkar**, M.Sc., Lecturer, Department of Statistics, Calcutta University, Ashutosh Building, Calcutta.
- Nandi, (Mrs.) Kanak**, Post-Graduate Department (Physiology), Calcutta University, 16, Narendra Sen Square, Calcutta 9.
- Nandi, (Mrs.) Kalyani**, 16, Narendra Sen Square, Calcutta 9.
- Nandi, Dr. P. N.**, M.Sc., Ph.D., Section of Microbiology, Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Nandi, S. K.**, M.Sc., A.R.I.C., 8, Lower Range, Calcutta 17.
- Nandi, S. K.**, M.Sc., Department of Chemistry, Sir P. C. Roy, Fellow of Calcutta University, 92, Upper Circular Road, Calcutta.
- Nandy, Sukumar**, Moghalpara, Post. & Vill. Hooghly, West Bengal.
- Nanjundayya, C.**, M.Sc., Ph.D. (Manch.), F.T.I., Director, Technological Laboratory, Matunga, Bombay 19.
- Narasimhan. A. S.**, B.Sc., 12, Soundara Rajan Street, Madras 17.
- Narayan, B. T.**, M.A., Ph.D., Deputy Director of Agriculture, Department of Agriculture (Govt. of Mysore), Seshadri Road, Bangalore.
- Narayana, Basudeva**, M.Sc., M.B., Ph.D., F.R.S.E., Principal, P. W. Medical College, Bankipore, P.O. Patna.
- Narayanan, E. S.**, M.A., Ph.D. (Lond.), D.I.C., F.R.E.S., F.E.S.I., Head of the Division of Entomology, Indian Agriculture Research Institute, New Delhi.
- Narlikar, V. V.**, B.Sc. (Bom.), B.A. (Cantab.), F.R.A.S., F.N.I., Head of the Dept. of Mathematics, Beneres Hindu University, Beneres.
- Narwani, C. S.**, M.Sc., 18, Shrimali Society, Naurangpura, Ahmedabad.
- Natarajan, B.**, M.A., D.Phil., Economic Adviser & Joint Secretary to the Government, Fort St. George. Block No. 8, Madras.
- Natarajan, C. V.**, B.Sc., M.B. & B.S., Dr. P. H. Superintendent, Public Health Institute, Bangalore.
- Nath, M. C.**, D.Sc., Professor and Head of the Department of Bio-chemistry, University of Nagpur, Nagpur.
- Nath, (Mrs.) M. C.**, C/o. Dr. M. C. Nath, D.Sc., F.N.I., University Department of Bio-chemistry, Nagpur.
- Nath, Mukti**, Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Nath, Ram**, M.Sc., In-Charge, Regional Soil Laboratory. 4, Cantonment. Benares, U. P.
- Nantial. S. P.**, Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Navalkar, B. S.**, M.Sc., Ph.D. Assistant Lecturer in Botany, Royal Institute of Science, Bombay 1., Sal Bhavan, 141, Princess Street, Bombay 2.
- Nayar, K. Karunakaran**, M.A., Ph.D. (Hons.), Lecturer in Zoology, University College, Trivandrum.
- Nayar, M. Raman**, Reader in Chemistry, Lucknow University, Lucknow.
- Nehru, Jawaharlal**, 17, York Road, New Delhi.
- Neogi, Hirendra Nath**, M.Sc., 13-1, Natherbagan Street, Calcutta 5.
- Neogy, S. K.**, 20, Rajani Sen Road, Calcutta 26.
- Nirula, R. L.**, B.Sc., Ph.D. (London), D.I.C., Vidarbhal Maha Vidyalaya, Amaravati, Madhya Pradesh.
- Niyogi, N. O.**, Lecturer, Bengal Engineering College, Post Botanic Gardens, Howrah.
- Nizam Sugar Factory Ltd.**, The, Shakarnagar, Via Nizambad, Hyderabad State, Deccan.
- North Bengal Sugar Mills Co., Ltd.**, Dalhousie Square, Calcutta 1.
- Nundy, L. C.**, A.M.I.E., Chief Engineer, 'Texmaco' Belgharia, P.O., 24-Parganas.

O

*Olpadvala, E. S., 52, Chowringhee Road, Calcutta.

Owers, Noel, Prof. of Zoology, College of Science, Nagpur.

P

Padmanabhan, C., B.E., M.I.E. (I) M.I.E.E. (Lond.), Chief Engineer. Electrical and Mechanical Department, Government of Rajasthan, Jaipur.

Padmanabhan, S. Y., Mycologist, C. R. R. Institute, P.O. Nayabazar, Cuttack.

Pai, Manmohan Laxman, Lecturer in Bio-chemistry, Medical College, Baroda.

Pakrasi, Benoy, M.Sc., C/o. Central Inland Fisheries Research Station, Manirampur, Barrackpore, 24-Parganas.

Pal, B. P., M.Sc., Ph.D. (Cantab.), F.L.S., F.N.I., Head of the Division of Botany and Asst. Director, Indian Agricultural Research Institute, New Delhi.

Pal, Naranjan, M.Sc., Lecturer in Biology, Victoria College, Cooch Bihar.

Pal, Nalinaksha. B.M.E., Special Assistant (Technical), 58-1D, Raja Dinendra Street, Calcutta 6.

Pal, Narendra Chandra, M.A., Bengal Junior Civil Service, Industrial Intelligence Officer, Directorate of Industries, Government of West Bengal, 8/48, Fern Road, Ballygunge, Calcutta 19.

Pal, Nil Krishna, Examiner of Stores, Directorate of Inspection, S. & D. Department, 1, Ganesh Chandra Avenue. Calcutta.

***Pal, Srikantha Bhusan**, 279B, Vivekananda Road, Calcutta 6.

Pal, Sarada Charan, B.Sc., B.E., A.M.I.E., Executive Engineer, Haglong P.O., Dist: N. C. Hills, Assam.

Palit, (Dr.) (Miss) H., Prof. of Pathology, Dept. of Pathology, 32, Lady Hardinge Medical College, New Delhi.

Palit, Ranendra Mohan, M.Sc., Chemist, Soil Engineering Wing, E.R.S., Rangehil Road. Kirkee, Poona.

Palit, (Dr.) Santi R., Prof. of Physical Chemistry, Dept. of Chemistry, Indian Association for the Cultivation of Science, Calcutta 32.

Pande, C. S., M.Sc., Ph.D., Lecturer in Chemistry, The University, Lucknow.

Pande, P. G., M.Sc., M.R.C.V.S., Principal, U. P. College of Veterinary Sciences and Animal Husbandary, Mathura, U.P.

Pandit, P. N., Research Scholar, Department of Chemical Technology, University of Bombay, Matunga, Bombay 19.

Panicker, C. G. G., B.Sc., B.Ch.E. (Hons.), A.M.G.I., A.M.I.I.Chem.E., Industrial Consultant, Ibcn Limited, 3, Queens Road, Bombay 1.

***Panikkar, N. Kesava, M.A., D.Sc.**, Trivandrum University Zoological Laboratory, Chepauk, Triplicane, P. O. Madras.

Panja, D., M.B., (Cal.), Officer-in-Charge, Department of Dermatology, School of Tropical Medicine, 250A, Chittaranjan Avenue, Calcutta.

Panja, G., M.B., (Cal.), D.B. (Lond.), F.N.I., Professor of Bacteriology and Pathology, Calcutta School of Tropical Medicine, Calcutta.

Panse, V. G., (Dr.) D.D.R., Nnstitute of Plant Industry, Indore.

Pant, Banshidhar, M.Sc., A.Inst.P., Asst. Research Officer, Central Water Power Irrigation & Navigation Research Station, Poona.

Parameswaran, H., M.A., Ph.D., D.Sc., F.Inst.P., Director of Industries, Travancore, "Harihar," 864, Thyand, Trivandrum.

- Paranjpe**, Gopal Ramchandra, I.E.S. (Retd.), F.N.I., O.B.E., 'Sudarshan', 202-1, Sadasiva Road, Poona 2.
- Paranjpe**, (Miss) Maina M., M.Sc., Ph.D., D.I.C., Assistant Lecturer, Royal Institute of Science, Mayo Road, Bombay 1.
- Paranjpe** M. K., Ph.D., Prof. of Physics, S. P. College, Poona 2.
- Parija**, Pankrishna, O.B.E., M.A. (Cantab), B.Sc., F.N.I., I.E.S., Vice-Chancellor, Banares Hindu University, Banares.
- Parikh**, G. M. C/o. The Zandu Pharmaceutical Works Ltd., Gokhale Road (South), Bombay 14.
- Parikh**, H. P., M.Sc., Excise Chemist. Technological Institute, Excise Laboratory. Baroda.
- Parikh**, S. C., Cahhganlal, Kapdi Pole, Baroda.
- *Parker**, R. N., F.C.H., C/o. Thos. Cook & Sons, Cape Town, S. Africa.
- Parthasarathi**, A., B.Sc. (Hons.), Asst. Prof. of Geology, Presidency College, Triplicane, Madras 5.
- Parthasarathy**, N., B.A., B.Sc., Ph.D. (Lond.), Head of the Botany Division, Indian Agricultural Research Institute, New Delhi.
- Parthasaraty**, (Dr.) S., D.Sc., F.Inst.P., F.R.I.C., 4, South Avenue, New Delhi.
- Parthasarathy**, S. V., Sugarcane Specialist, Anakapali.
- Pasricha**, B. R., M.Sc., Lecturer in Mathematics, Armed Forces Academy, P. O. Inter Service Wing, Dehra Dun, (U.P.)
- Patadia**, Chunilal Dayabhai, Asst. Planning Officer, Dr. C. D. Patadia, Alembic Coloney, Baroda.
- Patel**, Tribikram, M.A., 121, G. N. The Hostel, Allahabad University, Allahabad.
- Patel**, Bhailalbhai D., Chemist (Pharmacy), Sadar Bazar, Fateganj Camp, Baroda.
- Patel**, B. V., B.Sc., B. Pharm. (Lond.), Ph.C., B.M.S., The Drugs Controller for the State of Bombay, Manekji Wadia Building. 127, Mahatma Gandhi Road, Bombay 1.
- Patel**, Chaturbahai Shankarbhai, B.A., M.Sc., Ph.D., Director of Technological Institute and Industrial Chemist, Baroda State, Baroda.
- Patel**, Ishwar N., Pharmacist, Dev Niwas, Dayalbhai Lane, Baroda.
- Patel**, Jayant G., Chemist (Pharmacy), B32, Alembic Coloney, Chemical Industries, P. O. Baroda.
- Patel**, J. S., M.Sc., Ph.D., F.I.A.Sc., Principal, Bihar Agricultural College, Sabour, P. O., Bhagalpur District.
- Patel**, M. D., M.Sc., Ph.D., Director and Secretary, Institute of Agriculture, Anand.
- Patel**, (Dr.) M. S., Ph.D. (Cantab), Consulting Engineer, Economic Geologist, Santa Cruz, Bombay 23.
- Patel**, P. C., M.B.B.S., (Bom.), Prof. of Anatomy, Medical College, Jaipur, Rasta Masjid Samariyan, Inside Ajmere Gate, Jaipur, Rajasthan.
- Patel**, Punjabhai, M., Chemist, opp. Mirsaheb's Wada, Raopura, Baroda.
- Patel**, Ramanlal, Sonawolla Buildings, No. 8D-16, Tardeo, Bombay.
- Patel**, Ratilal P., M.Sc., Ph.D., Principal, Lallubhai Motilal College of Pharmacy, Ahmedabad 6.
- Pate**, Shankerbhai Z., Chemist, Hathi Pole, Baroda.
- Patel**, (Miss) H., Prof. of Pathology, Lady Hardinge Medical College, New Delhi.
- Pathak**, J. D., Professor of Physiology, Medical College, Baroda.
- Pathak**, (Miss) Suman M., C/o. Dr. J. V. Bhat, Head of the Microbiology Department, St. Xavier's College, Cruishank Road, Bombay 1.
- Patwardhan**, K. A., Daly College, Indore.
- Patwardhan**, N. K., M.Sc., Ph.D., A.R.I.C., Officer-in-Charge. Central Building research Institute, Roorkee.
- Patwarhan**, Vinayak Anant, M.Sc., Willingdon College, Sangeli, (S.M.S.).

- Patwardhan, V. N.**, M.Sc., Ph.D., Director, Nutrition Research Laboratories, Indian Research Fund Association, Coonoor.
- Paul, Asoke Kumar**, M.Sc., (Cal.), Assoc. I.A.R.I., Economic Botanist, West Bengal. State Agricultural Research Institutes 230, Netaji Subhas Road, Calcutta 32.
- Paul, Anil Chandra**, 2/6B, Ram Krishna Lane, Calcutta 3.
- Paul, Srish Chandra**, Proprietor, Relief Roller Co., 4, Police Hospital Road, Calcutta.
- Paul, T. P.**, Electrical Engineer C.P.W.D., 14, Madan Street, Calcutta.
- Paulsseen, O. G. F.**, 32, Rampart Row, Bombay.
- Pelagalli, V.**, C/o. Alfredo Buoyoute (Geneva) Ltd., 1, Commercial Building, Cal.
- Phadke, S. P.**, Bacteriology, Section, Bombay Veterinary College, Parel, Bombay 12.
- Phatak, (Mrs.) Pramila T.**, opp. Babajipura Police Gate, Market Road, Borada.
- Pichmuthu, S.**, B.Sc., Ph.D., D.Sc. (Glas.), F.R.S.E., F.G.S., F.A.Sc., F.N.I., Director of Geology, Mysore Geological Department, Bangalore 1.
- Pillay, T. V. R.**, B.Sc., 2, Elgin Road (Flat No. 31), Calcutta 20.
- Pingale, S. V.**, B.Sc., Asst. Entomologist, Victoria Mills Compound, Gamdevi, Bombay 17.
- Pittie, Madan Lal**, Sri Sadan, 15, Narayan Dabholker Road, Malabar Hill, Bombay.
- Prabhat Film Co.**, Prabhatnagar, Poona 4.
- Pradhan, (Dr.) S.**, M.Sc., Ph.D. (Lond.), D.Sc. (Luck.), F.R.E.S., Insect Toxicologist, Division of Entomology, Indian Agricultural Research Institute, New Delhi.
- Pradhan, (Mrs.) V. B.**, Department of Biology, Siddhartha College, "Manickwa" Outram Road, Bombay.
- Prakash, Om**, Oil Export to U. P. Government, H. B. Technological Institute, Kanpur.
- Prakash, Prem**, M.Sc., National Physical Laboratories, Hillside Road, New Delhi.
- Prakash, Satya**, D.Sc., Secretary, Scientific Research Committee, Beli Avenue, Allahabad, U. P.
- Pramanik, S.K.**, M.Sc., (Luck.), Ph.D. (Dond.), D.I.C., Meteorological Office, Ganesh-Khind Road, Poona.
- Pranavananda, (Rev.) Swami**, (of the Holy Kallas and Manasarover) C/o. Messrs. Laxmilal Ananda Bros., P. O. Almora, U. P.
- Prasad, B. K. Ram**, D.Sc., M.I.E.E., Electric Grid Offices, Foreshore Rd., Bom. 1.
- Prasad, B. N.**, F.R.S.E., D.Sc. (Paris), Ph.D. (Edin.), M.Sc., M.B., D.T.M., (Cal.). Prof. of Pharmacology, P. W. Medical College, Bankipore. Abul Aas Lane, Patna.
- Prasad, B. N.**, D.Sc. (Paris), Ph.D. (Liverpool), F.N.I., "Lakshir Niwas" George Town, Allahabad.
- Prasad, Balbhadra**, D.Sc. (Lond.), Professor of Chemistry, Ravenshaw College Cuttack.
- Prasad, Jamuna**, M.A. (Cantab), Principal, Government Degree College, Ranchi.
- Prasad, Kali**, Professor and Head of the Department of Philosophy and Education Department of Philosophy, The University, Lucknow.
- Prasad, K. Narayan**, B.Sc., Geological Asst. Palaeontological. Sect., Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Prasad, Mata**, D.Sc., (Banares), F.N.I., Professor of Inorganic and Physical Chemistry, Institute of Science, Fort. Bombay.
- Prasad, M.S.**, M.Sc., Branch Manager, New Asiatic Insurance Co. Ltd., Brajkishore Path, Patna.
- Prasad, Bainsi**, O.B.E., D.Sc., F.R.S.E., F.L.S., F.Z.S., F.R.A.S.B., F.N.I., Director of Fisheries, Govt. of West Bengal, Writer's Building, Calcutta 1 H.A. 13, Tughlak Road, New Delhi.
- Prasad, Surajdeo**, M.Sc., Ph.D. (Lond.), D.I.C., Industrial Research Laboratory Government of Bihar, Patna University, P.O. Patna.

- Prosad**, Sital, M.Sc., Principal, D. A. V. College, Muzaffar Nagar.
- Principal**, G.R., Medical College, 10, J. A. Hospital, Gwalior.
- Principal**, Prince of Wales Technical School, Jorhat, Assam.
- Puntambekar**, S.V., M.Sc., Ph.D., Senior Research Chemist, Forest Research Institute, Dehra Dun, U. P.
- Puranik**, G. V., "Vishnuprasad," Paanvel-Kolaba, Panvel.
- Puranik**, Vaidya P. G., 'Vishnuprasad,' Paanvel-Koloba, Panvel.
- Pusalkar**, S.D., M.Sc., Technical Manager, Messrs. Paragan Products (1) Ltd., 'Usha' 118, Shivaji Park, Bombay 28.
- Pushkarnath**, M.Sc., Ph.D., Botanist, Potato Breeding Sub-Station, Simla 1.
- Purkaystha**, S., B.Sc., A.T.S.M.; 65A, Satis Mukherjee Road, Calcutta 26.

Q

- Qazilbash**, Nawazish Ali, C/o. Prof. M. Lekhorana, Dept of Chemical Technology, Matunga, Bombay.

R

- R. C. Roy & Co.**, Engineers & Contractors, 1, Beadon Square, Calcutta 6.
- Racine**, (Rev.) C., S.J., D.Sc. (Paris), Professor of Mathematics, Loyola College, P. O. Cathedral, Madras.
- Kadhakrishna**, B. P., Geologist-in-Charge, Bureau of Mineral Development Bagesharpura P. O., Hassan Dist. Mysore.
- Radio Lamp Works Ltd.**, Managing Agents: M/s. Kaycee & Co. Ltd., 3, Chittaranjan Avenue, Calcutta.
- Raghavan**, N. G. S., Major, Asst. Director, Malaria Institute of India, 22, Alipore Road, Delhi 2.
- Rahman**, S. A., Professor of Physiology, Medical College, Mohalla Lingumpally, Hyderabad-Deccan.
- Rai**, R. N., Lecturer in Physics, Delhi University, Delhi.
- Rai Dastidar**, Janadhir Krishna, B.E.E., Asst. Engineer, M/s. A. E. I. Manufacturing Co. Ltd., 22B, Sardar Sankar Road, Suit No. 5, Calcutta 29.
- Raina**, B. N., M.Sc., Geological Survey of India 27, Chowringhee, Calcutta 13.
- Raj**, B. Sundara, Diwan Bahadur, M.A., Ph.D., F.N.I., Parkview, Miller Road, Kilpauk, Madras.
- Raj, Das**, Proprietor, Scientific Glass Works, 2539, Bengali Mahalla, Ambala Cantt.
- Rajagopal**, K., M.Sc., M.B.B.S., Major, Associate Professor of Biochemistry and Nutrition All-India Institute of Hygiene and Public Health, 110, Chittaranjan Avenue, Calcutta.
- Rajagopalan**, C., M.Sc., Professor and Head of the Department of Geology, Dr. A. C. College, Alagappa College, P.O. Ramnad—Dist.
- Rajagopalan**, V. R., Director of Animal Husbandry, Chepauk, Madras 5.
- Rajan**, P. T., B.Sc., Research Student, University of Trivancore, 884, Thycaud, Trivandrum.
- Rajalakshman**, D. V., M.A., M.Sc., Lecturer in Statistics, University of Madras, Triplicane P. O., Madras 5.
- Rajderkar**, E. B., M.Sc., Industrial Physicist, Commissariat Building, Hornby Rd..

- Rajendran, A. T. Isac, B.Sc., (Hons.), Research Assistant, Marine Biological Station, Tuticorin.**
- Rajgarhia, Chand Mull, Giridih, Bihar.**
- Rajnath, M.Sc., D.I.C., Ph.D. (Lond.), F.N.I., Professor and Head of the Department of Geology & Geography, Banaras University, Banaras 5.**
- Rakshit, H., D.Sc., F.Inst.P., F.N.I., Department of Physics, Bengal Engineering College, P. O. Botanical Garden, Howrah.**
- Ram, Sahib, M.A., Dyal Singh College, Karnal, East Punjab.**
- Ram, Pars., M.A., Unesco Group Tension Research Project, Muslim University, Baid-Majid Marris Road, Aligarh.**
- Raman, D. Venkata, Asst. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.**
- [Raman, G. A., B.Sc., F.R.I.C., Officer on Special Duty, Goodless Wall (India) Ltd., Fergusson Road, Lower Parel, Bombay 13.**
- Ramanathan, K. R., Diwan Bahadur, M.A., D.Sc., F.N.I., Physical Research Lab., Navarangapura, Ahmedabad 9.**
- Ramanathan, V., Retd. Deputy Director of Agriculture, Nambodu, Mel Nemli P. O. Via Arni.**
- Ramanujam, S., M.A., Ph.D. (Lond.), Director, Central Potato Research Institute, Post Box No. 136, Patna.**
- Ramaswami, L. S., Department of Zoology, Central College, Bangalore.**
- Ramchandra, R. B., M.A., 18, Rajpur Road, Civil Lines, Delhi 2.**
- Ramchandran, G. N., Department of Physics, Indian Institute of Science, Bangalore 3.**
- Ramdas, L. A., M.A., Ph.D., F.N.I., Agricultural Meteorologist, Meteorological Office, Poona 5.**
- Ramasarma, G. B., Ph.D., F.R.I.C., A.I.I.Sc., Raptakos, Brett & Co. Ltd., Worli, Bombay 18.**
- Ramiah, K., M.B.E., M.Sc., Dip-Agri. (Cantab), L.Ag., Agricultural Officer, F.A.O. (E.T.A.P.), F.A.O. Regional Office for Far East and Asia, Maliwan Mausin Phka Atit Road, Bayko.**
- Ranade, Shridhar Balkrishna, B.A., M.Sc., Bombay Educational Service, Lecturer in Biology, 435, Bhagwat Bunglow, 15, Road, Khar, Bombay.**
- Randhawa, M. S., M.Sc. F.N.I., I.C.S., Rehabilitation Commissioner, Punjab, Jullunder City.**
- Rangan, V. A. K., B.A., F.R.E.S., No. 5, Gopalakrishna Road, Thyagaryanagar, P.O. Madras 17.**
- Rangaswamy, M. B., A.M.I.E., Deputy Director, Central Works & Power Commission, P. A. to the Chief Engineer, Hirakund.**
- Ranjan, Sri., (Prof.), M.Sc., D.Sc., Head of the Botany Dept. Allahabad University, Allahabad.**
- Rao, Dr. A. L. Sundara, M.Sc. (Hons.), D.Sc., Planning Officer, Central Leather Research Institute, Guindy, Madras 15.**
- Rao, Balabheem, Central Laboratories for Scientific and Industrial Research, Hyderabad-Deccan.**
- Rao, B. Rama, M.A., D.I.C., F.G.S., F.N.I., Director, Mysore Geological Department 'Srivilas,' Visvesvarapur, Bangalore City.**
- Rao, B. Sanjiva, M.A., Ph.D. (Lond.), D.Sc., F.N.I., H.E.H., The Nizam's Professor of Inorganic and Mineral Chemistry, Indian Institute of Science, Malleswaram, Bangalore.**
- Rao, Dr. B. Subba, M.A., LL.B., Ph.D., Adhyapak Niwas, Pratapganj, Baroda.**
- Rao, B. S. Madhava, D.Sc., Head of the Department of Mathematics, Central College, Bangalore.**

- Rao, (Mrs.) C. Bhargavi, C/o. Dr. C. R. Rao, Statistical Laboratory, Presidency College, Calcutta.
- Rao, Rao Sahib, C. J. Dasa, Andhra University, Waltair.
- Rao, Dr. C. R., Indian Statistical Institute, Presidency College, Calcutta.
- Rao, G. Rama, M.Sc., A.R.I.C., Osmania Technical College, Hyderabad-Deccan.
- Rao, G. S. Raghunath, B.Sc., M.B.B.S., D.Phil. (Oxon.), Asst. Professor of Pharmacology, University Medical College, Mysore, (S. I.).
- Rao, H. Srinivasa, M.A., D.Sc., Central Marine Fisheries Research Station, Triplicane, P. O., Madras.
- Rao, I. Ramakrishna, M.A., Ph.D., (Cal.), D.Sc. (Lond.), Mg. Director General Engineering & Scientific Co., Mahavanipeth P. O., Visakhapatam.
- Rao, J. C. Kameswara, Prof. of Physics, Nizam College, Hyderabad, Deccan.
- Ras, K. K. P. Narashiniha, M.Sc., A.R.I.C., C/o. F.A.O. of the United Nation Viale Termedi Caracalla, Rome, Italy.
- Rao, Dr. K. Rangdhama, M.Sc., Professor of Physics, Andhra University, Waltair.
- Rao, K. Subba, D.Sc., A.R.I.C., Senior Scientist, Govt. of India, Ministry of Defence, Defence Science Organisation, New Delhi.
- Rao, K. V. Krishnamurthy, B.Sc., M.M.G.I., Chief Geologist and Mining Engineer, Messrs. Daduwala & Co., Bhiliwara, Mewar.
- Rao, L. Narayana, M.Sc., Ph.D. (Lond.), F.R.M.S., Professor of Botany, Central College, Bangalore.
- Rao, L. Rama, M.A., F.G.S., F.A.Sc., F.N.I., Professor and Head of the department of Geology, University of Mysore, Central College, Bangalore.
- Rao, M. Srirama, M.Sc., Ph.D. (Glasgo), F. G.S., Reader, Department of Geology, Andhra University, Waltair.
- Rao, M. V. Radhakrishna, M.B.B.S., Ph.D., Assistant Director, Haffkine Institute, Bombay 12.
- Rao, Manningay Umanath, M.Sc., A.I.C., Analytical Chemist, Government Chemist, P. W. D., 'Shanti Nivas' Sardarpura, Jodhpur, Rajputana.
- Rao, N. S. Govinda, B.E. (Civil), A.M.I.E., Professor Department of Power Engineering and Electrical Technology, Indian Institute of Science, Bangalore 3.
- Rao, Poona Appaji, B.Sc., Industrial Chemist, Essential Oils & Aromatic Chemicals 27, Krishnarajendra Road, Baravanagudi Bangalore 4.
- Rao, P. S., B.Sc. (Eng.), M.R.S.A. (Eng.), 8-15, Aryanagar, Kanpur.
- Rao, S. Balakrishna, Navaratna Pharmaceutical Laboratories, P. O., Mathancheri, Cochin.
- Rao, S. R. Narayana, M.A., F.G.S., F.N.I., Head of the Geology Department, Lucknow University, Lucknow.
- Rao, Dr. S.R., M.Sc., D.Sc., Parasitologist, Civil Veterinary Dept., Bombay Veterinary College, Parel, Bombay.
- Rao, S. Ramachandra, M.A., Ph.D., D.Sc. (Lond.), F.Inst.P., Professor of Physics, Central College, Bangalore.
- Rao, Y. Ramchandra, Rao Bahadur, M.A. F.R.E.S., 7, Kankanapall Road, Basavanagudi, Bangalore.
- Rao, V. L. S. Prakasa, M.A., D.Phil., Geography Department, Calcutta University, Senate House, Calcutta.
- Ray, G. S., Soil Conservation Laboratory, Damodar, Hazaribagh, (Bihar).
- Ray, Gautam Sankar, Lecturer in Anthropology Department of Anthoropology, University of Science, 35, Ballygunge Circular Road, Calcutta.
- Ray, Dharendra Nath, M.Sc., Kavis lekhar, 4D, Indian Mirror Street, Calcutta 14.
- Ratnagar, R. D., I.S.E., (Retd.), General Secretary, Institute of Engineers (India) 8, Gokhale Road, Calcutta 20.

Ravalgaon Sugar Farm Ltd., Ravalgaon (Nasik District).

Rau, A. Subba, B.A., D.Sc., F.R.M.S., Professor of Zoology, Central College, Bangalore.

Ray, Harendra Nath, M.Sc., P.R.S., Ph.D. (Lond.), F.N.I., Officer-in-Charge, Section of Parasitology, Indian Veterinary Research Institute, Mukteshwar, Kumaun.

Ray, Irishikesh, B.Sc., F.R.G.S. (Lond.), Irpala, Midnapur.

Ray, J. C., M.D., Director, Indian Institute for Medical Research, P-27, Princep Street, Calcutta.

Ray, Dr. J. N., Teddington Chemical Factory Ltd., Suren Road, Andheri, Bombay.

Ray, Karunamay, B.Sc., (Cal.), B.Sc. Hons., (Lond.), A.M.Inst.C.E., A.M.I., Struct. E., Chartered Civil Engineer, Resident Engineer, H. C. I. Socy., Ltd., Hindusthan Life Office, 6-A, Surendranath Banerjee Road, Calcutta.

Ray, N., M.Sc., Bengal Immunity Co. Ltd., Baranagar P. O., 24-Parganas.

Ray, N. C., M.Sc., Deputy Director, Agricultural Marketing Branch, Government of West Bengal, Writers Building, Calcutta.

Ray, Priyada Ranjan, M.A., F.N.I., Palit Professor and Head of the Department of Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.

Ray, R. C., D.S., F.R.I.C., F.I.I.Sc., F.N.I., Emeritus Professor of Chemistry, B. M. Das Road, Patna 4.

Ray, S. C., B.Sc. (Cal.), Tech. (Manchester), Chief Electrical & Mechanical Engineer, The Chirimiri Collieri P. O. Chirimiri, B. N. Rly.

Ray, S. C., B.A., (Cal.) B.S., Agri. (Wales), B.Sc. (Hons.), A. Econ. (Wales), Deputy Director of Agriculture, West Bengal, 33, Baker Road, Alipore, Calcutta.

Ray, S. N., M.Sc., Ph.D. (Cantab), Sigma, XI (U. S. A.), Indian Veterinary Research Institute, Izatnagar, U. P.

Ray, Chaudhuri, S. P., D.Sc. (Lond.) Ph.D. F.R.I.C., F.N.I., (Lond.) Head of the Division of Agricultural Chemistry and Soil Science, India Agri. Res. Inst. New Delhi 12.

Ray Chaudhuri, S. P., M.Sc. (Cal.), D.Sc. (Lond.), Ph.D., F.L.S., Assoc. I.A.R.I., Assistant Virologist, Indian Agricultural Research Institute, New Delhi.

Ray Chaudhuri, S. P., M.Sc., Ph.D. (Edin.), Lecturer in Zoology, University College of Science, 35, Ballygunge Circular Road, Calcutta.

Ray Chaudhury, Tarak Chandra, M.A., B.L., Lecturer in Anthropology, Calcutta University, 32/B, Allenby Road, Calcutta 20.

Razack, H. M. Abdul, Chirag Ali Lane, Hyderabad-Deccan.

Rege, Raghunath Dattaji, Ph.D., A.I.I.Sc., Sugarcane Specialist, Sugarcane Research Scheme, Pedgaon, Post Nira R. S., Dist. Poona.

Richaria, Dr. R. H., Economic Botanist to the Government of Bihar, Sabour, Bhagalpur.

Rivers, W. F., Standard Vacuum Oil Co. Ltd., 6, Church Lane, Calcutta.

Rizvi, S. M. Tahir, B.A. (Hons.), (Lond.), Ph.D. (Lond.), M.A., LL.B., F.R.G.S., F.R.M.S., Bar-at-Law, Chairman, Department of Geography, Muslim University, Aligarh.

Rohatgi, Binary Krishna Chemist and Industrialist, 45, Armenian Street, Calcutta.

Rohatgi, (Miss) Krishna Kamini, M.Sc., 7, Fyfield Road, Oxford, U.K.

Rohatgi, S. C/o. Hind Chemicals Ltd., Sarkar Road, Cantt. Kanpur.

Rohtas Industries Ltd., Dalmianagar, (Bihar) Rly. Station, Dehri-on-Sone, E. I. Rly.

Roy, Anukul Chandra, M.Sc., 2, Panchanantola Street, P. O. Belur Math, Howrah.

Roy, A. M.S. (Cal.) P.R.S., Ph.D. (London), Department of Physiology, U. P. College of Veterinary Science and Animal Husbandry, Mathura, U. P.

Roy, A. Barman, M.A., 23, Sarkar Lane, Calcutta 7.

- Roy, Sri Benoy Kumar**, Branch Manager, Indian Telephone Industries Ltd., 138, Canning Street, Calcutta.
- Roy, Brati Sarkar**, Ph.D., Lecturer, Department of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.
- Roy, David**, M.B.E., A.C.S. Dewan, Myllem-Cherra State, Shillong, Assam.
- Roy, Deb Kumar**, Managing Director, M/S. M. K. Roy Ltd., Jainti P. O., Jalpaiguri.
- Roy, Durlov Kumar**, Research Assistant, University College of Science, 92, Upper Circular Road, Calcutta 7.
- Roy, H.L.**, A.B. (Harvard), Dr. Ing. (Berlin), M.I.C.H.E., Professor-in-Charge of the Chemical Engineering Department, College of Engineering and Technology, Bengal, P. O. Jadavpur College (24-Parganas), Calcutta 32.
- Roy, J. K.**, B.Sc., C.E., M.I.S.I., A.M.I.E., Executive Engineer, Irrigation Division, Bankura, West Bengal.
- Roy, K. B.**, A.R.S.E. (Retd.) B.I.M.I.E. (Ind.), 2, Sambhu Nath Pandit Street, Calcutta 20.
- Roy, Kamakshya Charan**, B.A., A.M.A.E., Engineer, Messrs. Electric Stores & Engineering Co., 13A, Russell Street, Calcutta.
- Roy, (Major) N.K.**, M.B., D.P.H., Ex-I.M.S., Director, M. P. Vaccine & Public Health Institute, Nagpur 3.
- Roy, N. K.**, M.B., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Roy, Pratap Chandra**, Lecturer, Mechanical Engineering Department, College of Engineering & Technology, Jadavpur, Calcutta 32.
- Roy, Rajat Kanti**, Engineer, 1A, Ikhdalia Place, Calcutta 19.
- Roy, Ramani Mohan**, Vice-Principal, Surendra Nath College, 24, Harrison Road, Calcutta.
- Roy, R. S.**, M.Sc., (Calif.), A.M.S.S., (V.S.I.), Horticulturist, Sabour P.O., Bhagalpore, Bihar.
- Roy, S.**, Superintendent, Coke Ovens 5, Office Road, Jamshedpur.
- Roy, Sukhamoy**, B.M.E., Engineer, The Bengal Belting Co. Ltd., Rishra P. O., Hoogly.
- Roy, Dr. S. C.**, D.Sc., Dept. of Applied Chemistry, 92, Upper Circular Road, Calcutta 9.
- Roy, S. C.**, Ph.D., Dairy Technologist, Indian Dairy Research Institute, Bangalore 1.
- Roy, Sudhansu Kumar**, M.Sc., Ph.D. (Lond.), D.I.C., Bose Research Institute, 93, Upper Circular Road, Calcutta 9.
- Roy, Dr. Sunil Kumar**, Research Officer, Central Waterways Irrigation & Steam Navigation Research Station, Poona.
- Roy, S. N.**, Manager, Bharatiya Engineering Works P. O. Sahibganj, Santhal Parganas.
- Roy, Sarojendra Nath**, M.Sc., Department of Psychology, University College of Science, 92, Upper Circular Road, Calcutta.
- Roy, Santosh K.**, Department of Geology, Presidency College, Calcutta.
- †**Roy, Satyendra Prasad**, Tea Planter, Post Box No. 59, Jalpaiguri.
- Roy, Surendra Kumar**, M.E.E., (Harvard), M.A.I.E.E., College of Engineering and Technology, Bengal, P. O. Jadavpur College, 24-Parganas.
- Roy, Taresh Charan**, M.Sc., D.Phil., Assoc. I.A.R.I., Asst. Mycologist, West Bengal, Slate Agriculture Research Institute, 230, Netaji Subhas Road, Tollygunj, Calcutta.
- Roy Chowdhury, Amitava**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Roy Choudhury, Anil Baran**, 16, Lansdowne Terrace, Calcutta 29.
- Roy Choudhury, B.**, Electrical Sectional Officer, C. P. W. D., Dhanbad, Fort, Bombay 1.

- Roy Choudhury, K.**, Specialist & Pioneer in the Manufacturer of Analytical Balances, 517/335, Nadeswar, Benares Cantt.
- Roy Choudhury**, Purna Chandra, 30/2, Banamali Chatterjee Street, Calcutta.
- Roy Choudhury, P.K.**, Senior Chemist, Processing Department, Kassipur Co. Ltd., P. O. Alambazar, Dist. 24-Parganas.
- Roy Choudhuri, H. K.**, B.Sc., Diplomaed Mining Engineer and Colliery Manager, 5/1, Woomesh Mukerjee Street, P. O. Belgharia, 24-Parganas.
- Roy Chaudhuri, N.**, B.Sc., I.C.S. District Magistrate & Collector, Hooghly.
- Roy Choudhry, R. K.**, B.Sc.Engg, Asst. Engineer, C. P. W. D., Electrical Sub-Division, 14, Madan Street, Calcutta.
- Roy Choudhury**, Sudhir Kumar, Director Messrs. Bien Artium Natural Sciences Ltd., 6, Mangoe Lane, Calcutta.
- Roy Chowdhury**, Sambhu Nath, Lecturer in Biology, Hooghly Mohsin College, Chinsurah, Dist. Hooghly.
- Roy Choudhury, S. N.**, B.Sc., A.M.I.E.C. (Lond.), Bombay Aviation, R.A.F. Barracks, Nehru Road, Vile Parle East, Bombay 24.
- ***Rubugunday, R. K.**, M.A. (Cantab), Wrangler Prize Winner, Professor of Mathematics, Saugor University, 12, Saugor Cantt., King's Road, C. P.
- Rudra, J. N.**, M.Sc., Prof. of Zoology, Vidyasagar College, 39, Sankar Ghosh Lane, Calcutta, Home Add. 1, Shib Narayan Das Lane, Calcutta.
- Rudra, M. N.**, Prof. of Medical Chemistry, Darbhanga Medical College, P. O. Laheria Sarai, Bihar.

S

- Sa,' Bailon De, M.Sc.**, Professor of Mathematics, St. Xaviers College, 30, Park St., Calcutta.
- Sadashivaiah, Dr. M. S.**, Senior Lecturer in Microbiology, & Patriology, Indian School of Mines & Applied Geology, Dhanbad.
- Sadasivan, T. S.**, M.Sc., Ph.D., Director, The University Botany Laboratory, Triplicane, P. O., Madras 5.
- ***Sadgopal, M.Sc.**, (Tech.), D.Sc., F.C.S., F.R.H.S., F.R.I.C., Department of Industrial Chemistry, College of Technology, Benares Hindu University, Benares.
- Sadhu, Dr. D. P.**, L.M.F., M.Sc., Ph.D., Dept. of Physiology, Presidency College, Calcutta.
- Saha, Ajit Kumar, M.Sc.**, Geological Assistant, Geological Survey of India, 4C, Sitaram Ghosh Street, Calcutta. 9.
- Saha, Amerandra Nath, M.Sc.**, Lecturer, Applied Chemistry Department, University College of Science, 92, Upper Circular Road, Calcutta.
- Saha, J. C.**, M.Sc., Ph.D., Plant Pathologist, Director of Plant Protection, Quarantine & Stores, Jamnagar House, Mansingh Road, New Delhi.
- Saha, Kamakhya Charan, M.Sc.**, C/o., National Industrial Trading Co., 71A, Netaji Subhas Road, Calcutta.
- Saha, H. L.**, M.Sc., Extra-Assistant Director Soil Mechanics Dept., Damodar Valley Corpn. P. O. Chirkunda, Maithon, Manbhum, Bihar.
- Saha, N. K.**, Department of Physics, University of Delhi, Delhi.
- Saha, Srish Kumar M.Sc.**, Research Chemist, Bengal Chemical & Pharmaceutical Works Ltd., 164, Manicktala Main Road, Calcutta.
- Sahana, D. P.**, Kodarma P. O., Dist. Hazaribagh.
- Sahasrabudhe, Dr. R. H.** Dept. of Chemistry, College of Science, Benares Hindu University, Benares.

- Sahasrabudhe, Y. S.**, Asst. Geologist, Geological Survey of India, Botawala Chambers, Sir Phroze Shah Mehta Road, Bombay.
- Sahu, V. K.**, M.Sc., Laxminarayan Reesearch Fellow, University Department of Biochemistry, Nagpur.
- Sahney, J. C.**, Executive Engineer, Lucknow Provl. Division, Lucknow.
- Sahni** Dr. M. R., M.A., Ph.D., D.Sc., Biological Survey of India, 18, Clyde Road, Lucknow.
- Saksena, Ram Kumar**, D.Sc., Reader in Botany, Allahabad University, Allahabad.
- Saletore, S. A.**, B.Sc., A.I.I.Sc., A.R.I.C., Ph.D. (L'Pool), Asst. Director, Central Laboratories for Scientific & Industrial Research, Distillery Compound, Narayanguda, Hyderabad-Deccan.
- Sane, J. B.**, M.Sc., A.R.I.C., Textile Chemist, Khatau Mills, Byculla, Bombay 8. Home Address 16, Sadashiv Street, Bombay 4.
- Saxsena, Eshwar Raj**, M.Sc., Research Scholar, Central Laboratories for Scientific and Industrial Research, Hyderabad-Deccan.
- Samanta, Joy Gopal**, Estimator, Calcutta Corporation, D.E.I., 194D, Maharsi Debendra Road, Calcutta 6.
- Sambamurthy, A. V.**, Asst. Engineer Planning & Progress, Telephone Work-shop, 86, Chowringhee Road, Calcutta 20.
- Sanitex Chemical Industries Ltd.**, The Chemical Industries, P.O. Industrial Area, Gorwa Road, Baroda 3.
- Sankalia, H. D.**, M.A., LL.B., Ph.D., Professor and Head of the Department of History, Deccan College, Post Graduate and Research Institute, Poona 1.
- Santapau, H.**, St. Xavier's College, Fort, Bombay.
- Sankaran, C. R.**, Reader-in-Charge of Phonetic Laboratory, Deccan College Research Institute, 10, Connaught Road, Poona 1.
- Sanyal, A. T.**, B.Sc., Ag., Assoc. I.A.R.I., Agronomist, Jute Agriculture Research Institute, Hooghly, West Bengal.
- Sanyal, B. B.**, M.R.S.I., M.R.San.I. (Lond.), C/o. Srikrishna Sarma, 36, Kalupara Lane, P.O. Bandhaghat, Howrah.
- Sanyal, Sudhir Nath**, B.Sc., M.B., C/o. Calcutta Bacteriological Institute, 105, Vivekananda Road, Calcutta 6.
- Sarabhai, (Mrs.) Mrinalini**, C/o. Vikram A. Sarabhai, Post Box 28, Ahmedabad.
- Sarabhai, Vikram A.**, M.A. (Cantab.), Ph.D., Prof. of Cosmic Ray Physics, Physical Research Laboratory, Navrangpura, Ahmedabad 9.
- Saraswati, Sugar Mills**, Abdullapur, Ambala District.
- Sarkar, A. K.**, B.Sc., D.I.I.Sc., A.M.I.E., Asst. Managing Engineer, Sibpur Power Station, P.O. Charanpur, Burdwan. Home Add.: 2-1, Monoharpukur Road, Calcutta 26.
- Sarkar, Anup Sundar**, A.M.I., Mech.E., Worthington Simpson, 10, Netaji Subhas Road, Calcutta.
- Sarkar, (Miss) Binita**, 14-2, Bhabha Nath Sen Street, Calcutta.
- Sarkar, (Miss) Bithika**, 14-2, Bhabha Nath Sen Street, Calcutta.
- Sarkar, Dr. Bijali Behari**, Head of the Department of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Sarkar, B. K.**, M. I. Metal, Chartered Engineer, Director, Agricultural Machinery Manufacturing Corporation Ltd., and National Aluminium Products, 14-2, Bhabanath Sen Street, Calcutta.
- Sarkar, H.**, 177, Upper Circular Road, P.O. Shambazar, Calcutta.
- Sarkar, Himangsu Sekhar**, Electrical Contractor, 17-A, South End Park, Calcutta 29.
- Sarkar, N. G.**, Director, Scientific Indian Glass Co., Ltd., 98, Christopher Road, Calcutta.

- Sarkar, P. B., Dr. S. C., A.I.C., F.N.I., University College of Science, 92, Upper Circular Road, Calcutta.
- Sarkar, R. K., C/o. Mr. B. K. Sarkar, 14-2, Bhabha Nath Sen Street, Calcutta.
- Sarkar, S. N., Ph.D., D.Phil. (Oxon.), Prof. of Organic Chemistry & Bio-chemistry Campbell Medical College, C/o. Dept. of Chemistry, Medical College, Calcutta.
- Sarkar, S. S., D.Sc., Anthropologist, Dept. of Anthropology, Indian Museum, Calcutta.
- Sarkar, Sudhangsu, B.Sc., Covenanted Assistant, M/s. Bird & Co., Chartered Bank Buildings, 17, Lansdowne Terrace, Calcutta 26.
- Sarkar, (Mrs.) Suniti, 33-3, Lansdowne Road, Calcutta.
- Sarkar, (Mrs.) Uma, Director, Agricultural Machinery Manufacturing Corp. Ltd., 38-1, Bose Para Lane, P.O. Bagbazar, Calcutta.
- Sarma, Jyotirmoyee, Ph.D., Anthropologist, Dept. of Anthropology, Government of India, Indian Museum, Calcutta 13.
- Sarma, (Mrs.) Kamalmani, M.Sc., Assistant Geophysicist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Sastry, B. J., B.E., A.M.I.E., 5/111-B, Maithoi, D. V. C., Manbhum.
- Sarma, Rama Kanta, A.M.I.E.E., Electrical Engineer, C/o. Messrs. Guest Keen Williams Ltd., 41, Chowringhee Road, Calcutta.
- Sastry, B. S. R., Scientific Officer, Central Laboratories for Scientific and Industrial Research, Jamai-Osmania P.O., Hyderabad-Deccan.
- Sastry, N. S. N., M.A., D.Phil. Head of the Dept. of Social Sciences, Indian Institute of Science, Bangalore 3.
- Sastry, Dr. N. S. R., Director of Statistics, Reserve Bank of India, Post Box No. 1036, Bombay 1.
- Sastry, M. V. A., M.Sc., F.G.M.S., Asst. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Sastry, V. V. K., M.Sc., A.R.I.C., Managing Director & Chief Chemist, The Eastern Technical Laboratories Ltd., 6-C, Mowbray's Road, Royapettah, Madras 14.
- Sastri V. V., M.Sc., F.G.M.S., Geological Survey of India, 27, Chowringhee, Calcutta.
- Sawhney, Kalidas, Rai Bahadur, M.Sc., Secretary, Indian Central Cotton Committee, 14, Nicol Road, Ballard Estate, Fort, Bombay.
- Saxena, E. R., M.Sc., Research Scholar, Central Laboratories for Scientific and Industrial Research, Hyderabad-Deccan.
- Saxena, M. C., Lecturer in Physics, Lucknow University, Lucknow.
- Sayeed-ud-Din, M., M.A. (Edin.), B.Sc., F.R.M.S., Professor of Botany, Osmania University, P.O. Lallaguda, Hyderabad-Deccan.
- Schroff, Mahadeva, L., A.B. (Hons.) (Cornell.), M.S. (Mass.), Supdt., Chemist, Birla Brothers Ltd., 8, Royal Exchange Place, Calcutta.
- Schwarz, Anton, C/o. The Indian Standard Metal Co., Ltd., Chinchpokli Cross Lane, Bombay 27.
- Scientific Apparatus & Chemical Works Ltd., The Agra, Uttar Pradesh.
- Seal, Satis Chandra, M.A., B.L., General Secretary, Indian Research Institute, 1, Gour Laha Street, Calcutta 6.
- Seal, Jagat Kanta, Artleoricultural Overseer, Calcutta Corporation, 18, Sidheswar Chandra Lane, Calcutta 12.
- Seal, Kiron Chandra, 35, Parasar Road, Calcutta 29.
- Seal, (Dr.) Srish Chandra, M.B., D.P.H., F.A.P.H.A., Asst. Prof. of Epidemiology, All India Institute of Hygiene and Public Health, Calcutta.
- Seal, Sudhindra Kumar, 2, Cornwallis Street, Calcutta 6.
- Sehra, K. B., M.Sc., Ph.D., C. M. P. Laboratory, Poona.
- Selvarangan, R., B.Sc., B.Sc. (Tech.), Junior Scientific Assistant, Central Leather Research Institute, Madras 15.
- Sen, A. B., M.Sc., Ph.D., Reader in Chemistry, Lucknow University, Lucknow.

- Sen, A. N.,** M.A., B.Sc. (Glass.), M.I.E. (Ind.), 32, Ballygunge Place, Calcutta.
- Sen, Achinta Kamal,** M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Sen, Alok,** M.Sc., Professor of Botany, Vidyasagar College, 39, Sankar Ghose Lane, Calcutta.
- Sen, Amitava,** M.Sc., Ph.D. (Leeds.), 22B, Nalin Sarkar Street, Calcutta 4.
- Sen, Anil Bhusan,** B.Sc., C.P.E., M.I.E., M.M.G.I., Suptg., Engineer, C. P. W. D., 65, Hindusthan Park, Calcutta 29.
- Sen, Anil Kumar,** 15, Ballygunge, Calcutta.
- Sen, Asoke Kumar,** M.Sc., Managing Director, East India Pharmaceutical Works Ltd., 71, Russa Road, Calcutta.
- Sen, Binayendra Nath,** "Mithapukur", Burdwan.
- Sen, Basiswar,** B.Sc., Director, Vivekananda Laboratory, Almora, Uttar Pradesh.
- Sen, Bibhuti Bhusan,** D.Sc., Head of Dept. and Prof. of Mathematics, Presidency College, Calcutta.
- Sen, Dharanidhar,** M.Sc., Lecturer, Dept. of Anthropology, Calcutta University, Calcutta, Res.: 91/11-A, Tollygunge Road, Calcutta.
- Sen, Dr. D. K.,** University, Department of Chemical Technology, Bombay 19.
- Sen, Gopal Chandra,** Professor, C. E. T. Bengal, P.O. Jadavpur College, Calcutta 32.
- Sen, H.,** Geologist, Prospecting Dept., Tata Iron & Steel Co., Ltd., Jamshedpur.
- Sen, Hari Pada,** Asst. Professor of Physics, Jadavpur Engineering College, Calcutta 32.
- Sen, Harakali,** Chief Coal Inspector, Jamaduba Jealgora P.O., District Manbhum.
- Sen, Indra,** M.A., Ph.D., Sri Aurobinda Asram, Pondicherry.
- Sen, J. K. (Capt.),** M.B., D.T.M., 18, Kasinath Dutt Road, Baranagore, 24-Parganas.
- Sen, J. M.,** M.Ed. (Leeds.), B.Sc. (Cal.), T.D. (Lond.), Dip-Ed. (Oxford), F.R.G.S., F.N.I., P.O. 28, New Road, Alipore, Calcutta.
- Sen, J. R.,** Engineer, M.M.E.A., M.I.S.E., Engineer, B. P. Mills, Raniganj, E. I. Rly.
- Sen, Joytish Chandra,** A.M.A.E., Architect, Engineer & Contractor, 4/11/2, Ekdalia Road, Calcutta 19.
- Sen, K. B.,** M.Sc., A.I.C., Chemist-in-Charge, Messrs. Bird & Co.'s Research Institute, Chartered Buildings, Clive Street, Calcutta.
- Sen, K. P.,** Mining Engineer & Manager, Pure Ganeshpur Colliery, Nawagarh P.O., Dist. Manbhum.
- Sen, Kshitish Chandra,** Chemist, Titagar Paper Mills, Titagar, 24-Parganas.
- Sen, M.,** D.Sc., A.R.I.C. (Lond.), Quinologist to the Govt. of West Bengal, Mangpoo, Darjeeling.
- Sen, M. K.,** Indian Jute Mills. Association, Research Institute, 3, Taratola Road, Calcutta 27.
- Sen, N. K.,** M.A., D.Sc., F.R.I.C., F.N.I., Professor and Head of the Department of Chemistry, Presidency College, 7-5, Benod Saha Lane, Calcutta 6.
- Sen, Nalinbihari,** M.Met., B.Sc., F.R.I.C., F.I.M., Technical Asst. to Director, Tata Industries Ltd., 34, Circuit House Area, Jamshedpur.
- Sen, Nikhil Ranjan,** D.Sc., Ph.D., Department of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.
- Sen, Nirmal Chandra,** A.M.E.E., Works Manager, Engineer, The Bengal Electric Lamp Works Ltd., Jadavpur, Calcutta 32.
- Sen, Nirmal Kumar,** B.Sc., Asst. in the Coke Oven Dept., The Indian Iron & Steel Co., Ltd., Hirapur Works, Burnpore, B. N. Rly.
- Sen, Nirmalendu,** Upper Sub-Ordinate Overseer, Calcutta Corporation, 21-1, Kali Prasad Banerjee Lane, Howrah.
- Sen, (Dr.) P. B.,** Department of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.

- Sen, (Dr.) P. K.**, Physician-in-Charge, Chest Department, Medical College Hospital, Calcutta.
- Sen, P. K.**, M.Sc. (Cal.), Ph.D. (Lond.), D.I.C., F.B.S., Khaira Prof. of Agriculture, Calcutta University, Agricultural College and Research Institute, P.O. Jhargram, West Bengal.
- Sen, Parimal**, B.Sc. (Tech.), Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Sen, Purnendu**, M.Sc., Ph.D., D.I.C., Entomologist, Directorate of Health Services, Govt. of West Bengal, School of Thopical Medicine, Calcutta.
- Sen, R. N.** M.A., Ph.D., Lecturer in Pure Mathematics, Calcutta University, 30, Mohan Bagan Lane, Block 11, Calcutta 4.
- Sen, Ranjit Kumar**, M.Sc., Research Asst., Indian Asscn. for the Cultivation of Science, Jadavpur, Calcutta 32.
- Sen, S. C.**, M.Sc., Assoc. I.A.R.I., F.R.I.C., Sugarcane Chemist, Pusa.
- Sen, S. C.**, Agriculturist & Industrial Chemist, 10, Chowringhee, Calcutta.
- Sen, S. K.** M.Sc., Hotel Savoy, 27, Sashi Bhusan Dey Street, Calcutta 12.
- Sen, S. N.**, Chemist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Sen, S. N.**, Indian Association for the Cultivation of Science, Jadavpur, Calcutta 32.
- Sen, Satindra Kumar**, Professor of Physiology & Vice-Principal, R. G. Kar Medical College; Res.: 43-3, Hazra Road, Calcutta 19.
- Sen, Satya Prasanna**, M.Sc., Manager and Secretary, Bengal Chemical and Pharmaceutical Works, Ltd., 164, Manicktollah Main Road, Calcutta.
- Sen, Saurindranath**, Dept. of Geology, University of Calcutta, Geological Laboratory, Presidency College, Calcutta.
- Sen, Sudhir Chandra**, M.Sc., Agronomist, Divn. of Agronomy, Indian Agricultural Research Institute, New Delhi.
- Sen, Sunil Chandra**, Professor of Physiology, Presidency College, Calcutta.
- Sen, Syamapada**, M.Sc., Sir J. C. Bose, Scholar, Bose Institute, 93, Upper Circular Road, Calcutta 9.
- Sen, Triguna**, (Dr.) Ing. (Munich), A.M.M.E. (B.Tech. Ind.), A.M.I.E. (Lond.), Principal, College of Engineering and Technology, Bengal, P.O. Jadavpur College, Calcutta 32.
- Sen Choudhury, Paresh Kishore**, M.Sc., D.Phil., Department of Physics, Presidency College, Calcutta.
- Sen Gupta, Ananta Mohan**, Lecturer, Bengal Engineering College, 243, G. T. Road, Shibpore. Howrah.
- Sen Gupta, Bhupendra Chandra**, Sen Gupta Electroplating Works, 84, Dharamtolla Street, Calcutta.
- Sen Gupta, C. M.**, Section of Parasitology, Indian Veterinary Research Institute, Izatnagar, Bareilly.
- Sen Gupta, Dinesh Chandra**, 17A, Gopal Nagar Road, Calcutta 27.
- Sen Gupta, Harashit**, National Institute of Science of India, University Building, Delhi.
- Sen Gupta, H. L.**, Managing Director, Union Bank of Bengal, 8, Netaji Subhas Road, Calcutta.
- Sen Gupta, H. N.** M.A., Ph.D., Professor of Mathematics, Krishnanagar College, Nadia, West Bengal.
- *Sen Gupta, (Dr.) J. C.**, Dr. Phil. Nat. (Heidelberg), M.Sc. (Cal.), Senior Prof. of Botany, Presidency College, 2, Bepin Pal Road, Calcutta 26.
- Sen Gupta, K.**, Research Officer, Soil Conservation Department, D.V.C., Hazaribagh.
- Sen Gupta, K. C.** B.O.T. Boiler Engineer, Indian Iron & Steel Co., Ltd., P.O. Burnpur, Dist. Burdwan.

- Sen-Gupta, M.**, B.Sc. (Cal.), B.Sc. (Eng.), C.P.E. (Gals.), M.I.E.E. (Lond.), M.I.E. (Ind.), A.M.I.M.E. (Lond.), F.I.P.S., Principal, Engineering College, Benares Hindu University, Benares.
- Sen Gupta, Manick Lal**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Sen-Gupta, N. C.**, D.Sc., F.R.I.C., M.Inst.Pet., A.R.I.E., Senior Fields Chemist, The Burmah Oil Co. (I.C.), Ltd., P.O. Digboi, Upper Assam.
- Sen Gupta, N. D.**, Physics Department, Ramnarayan Ruia College, Bombay 19.
- Sen Gupta, N. K.**, Director of Telegraph Engineering, Posts & Telegraphs Department, Alipore, Calcutta.
- Sen Gupta, Nirmal Kumar**, Chemical Plant & Equipment Ltd., 7, Lower Chitpur Road, Lalbazar, Calcutta 1.
- Sen Gupta, Pratul Nath**, M.Sc., Ph.D., A.R.I.C., Bio-chemist, Dept. of Anthropology, Govt. of India, 27, Chowringhee, Calcutta.
- Sen Gupta, P. B.**, Secretary, Dunlop Rubber Co., Ltd., Free School Street, Calcutta.
- Sen Gupta, P. C.**, M.B., Officer-in-Charge, Kala-azar Research Department, School of Tropical Medicine, Calcutta.
- Sen Gupta, P. N.**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Sen Gupta, Probhat Kumar**, Director, International Printing Machinery Ltd., P-39, Princep Street, Calcutta 13.
- Sen Gupta, Pratul Nath**, M.Sc., Ph.D., A.R.I.S., Bio-chemist, Dept. of Anthropology, Govt. of India, 27, Chowringhee, Calcutta.
- Sen Gupta, S.**, B.Sc., Junior Asst. Manager, Coke-Ovens, Hirapur Works, Indian Iron & Steel Co., Ltd., Burnpur P.O., Dist. Burdwan.
- Sen Gupta, S. C.**, M.D. (Edin.), F.R.C.S. (Edin.), F.S.M.F., Principal, Calcutta National Medical Institute, 32, Garcha Road, Calcutta 14.
- Sen Gupta, S. C. (Capt.)**, Director of Postal Services (Planning), Post & Telegraph Directorate, New Delhi.
- Sen Gupta, Sudhir Ranjan**, B.Sc., Ph.D., A.M.I.E., Principal, Bengal Engineering College Shibpore, Howrah.
- Sen Gupta, Sadashiv**, 90, Raja Basanta Roy Road, Kalighat P.O., Calcutta.
- Sen Gupta, Sushil Kumar**, A.M.A.E., Engineering Overseer, Calcutta Corporation, 15B, Jagadish Nath Roy Lane, Calcutta 6.
- Sen Gupta, Sudhindra Narayan**, Asst. Geophysicist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Seshachar, B. R.**, D.Sc., F.Z.S., Professor of Zoology, Depil of Zoology, Central College, Bangalore.
- Seshadri, T. R.**, M.A., Ph.D., F.I.C., Head of the Dept. of Chemistry, University of Delhi, Delhi.
- Seshagiri, P. V. V.**, M.Sc., Reader in Botany, Andhra University, Waltair.
- Seshaiya, R. V.**, M.A., Professor of Zoology, Annamalia University, Annamalainagar, S. India.
- Set, Dinabandhu**, M.B., Drug License & Quinine Officer, West Bengal, Res.: 45A, Hari Ghosh Street, Calcutta 6.
- Seth, B. R.**, D.Sc. (Lond.), Hindu College, Delhi.
- Seth, Govind Ram**, Professor of Statistics, Indian Council of Agricultural Research, Man Singh Road, New Delhi.
- Seth, Phanindra Nath**, Hon. Secretary, Indian Decimal Society, Romak-Lipi Samity, 29-1A, Baldeopara Road, Calcutta 6.
- Sethi, Mehra Chand**, Professor of Botany, Bhargava Municipal College, Simla.
- Sethna, (Dr.) Suresh**, Reader in Organic Chemistry, Sayaji Jubilee Science Institute, M. S. University, Baroda.

- Setna, S. B., Ph.D., F.R.M.S.,** Fisheries Officer, Department of Industries, Old Custom House, Bombay.
- Shabdc, N. G., D.Sc.,** Principal, M. Mahavidyalaya, Jubbulpore.
- Shadaksharaswamy, M., M.Sc., Ph.D. (Edin.), A.R.I.C.,** Professor of Chemistry, First Grade College, Tumkur.
- Shah, (Dr.) Chimanlal B.,** Chief Chemist, Alembic Chemical Works Co., Ltd., Baroda.
- Shah, C. C., M.Sc., Ph.D., F.R.I.C.,** Professor of Chemistry and Head of Animal Nutrition Section, Institute of Agriculture, Anand, B. B. & C. I. Rly.
- Shah, H. L., M.Sc.,** Extra Asst. Director, Soil Mechanics Department, Damodar Valley Corporation.
- Shah, Kantilal A., M.B.B.S.,** Medical Officer-in-Charge, Ranchhodlal Dispensary, 1, Panekhuwa, Ahmedabad.
- Shah, M. L., M.Sc., Ph.D.,** Professor of Chemistry, M. N. College, Visnagar.
- Shah, M. S., M.Sc. (Bom.), Ph.D. (Lond.), D.I.C.,** Professor of Chemistry Gujarat College, Ahmedabad.
- Shah, (Dr.) N. M.,** Dept. of Chemistry, Gujrat College, Ahmedabad.
- Shah, P. G., M.A., B.S., I.A.A.S.,** Lalit Kunj, 11th Road, Khar, Bombay 21.
- Shah, (Miss) R.,** Chief Agricultural Research Officer, Harry Ferguson of India Ltd., Bangalore.
- Shah, R. C., M.Sc., Ph.D. (Lond.), A.I.I.Sc.,** Professor of Organic Chemistry, Royal Institute of Science, Fort, Bombay 1.
- Shankar, Jagdish, M.Sc., Ph.D., A.R.I.C.,** Kenilworth, 53, Pedder Road, Bombay 26.
- Sharma, K. D., M.Sc., Assoc., I.A.R.I.,** Agronomist, Indian Sugarcane Research Sub-Station, Patna.
- Sharma, N. L.,** Professor of Geology, Indian School of Mines & Applied Geology, Dhanbad.
- Sharma, P. N., D.Sc.,** Department of Physics, Lucknow University, Lucknow.
- Sharma, R. S., H. L. College of Commerce, Ahmedabad 9.**
- Shastri, N. A.,** King Edward College, Amaraoti, Berar.
- Shaw, Joseph S.,** Asst. Director of Fisheries, P.O. Kodinar, Kathiawar.
- Short, G. V., Col. M.R.C.V.S.,** Veterinary Service Department, I.C.I. (India) Ltd., 18, Strand Road, Calcutta.
- Suree Hanuman Sugar Mills Ltd.,** 178, Harrison Road, Calcutta.
- Shrinivasan, K. V., M.Sc.,** C/o. M/s. Visconti Sons & Co., 9, Wallace Street, Fort, Bombay.
- Shroff, D. P.,** Associated Instrument Manufacturers (India) Limited, B-5, Clive Building, Calcutta 1.
- Sidhu, G. S., M.Sc., B.Sc. (Hon.), Ph.D.,** Scientific Officer, Central Lab. of Scientific Industrial Research, Jama-Osmania P.O., Hyderabad.
- Sikka, L. C.,** Milk Commissioner-Cum-Administrator, Haringhata Centre, 22, Chittaranjan Avenue, Calcutta.
- Singh, B. N., D. Sc.,** Professor of Physics, Science College, Patna.
- Singh, Bawa Kartar, M.A. (Cantab.), Sc.D., F.I.C., F.N.I.,** Hony. Research Professor of Chemistry, Benares Hindu University, Benares, U.P.
- Singh, Baldev, B. Pharm., B.Sc.,** Central Laboratories for Scientific and Industrial Research, Lallaguda P.O., Hyderabad, Deccan.
- Singh, Chhotey, B.Sc. (Agr.),** Entomological Assistant, C/o. The Entomologist to Government of Kanpur, U.P.
- Singh, Durganand, Banalli House, Patna 1.**
- Singh, Rudra Pal, M.Sc.,** Lecturer, Physics Department, Allahabad University, Allahabad.
- Singh, Sardar Kartar, Asst. Blast Furnace Manager, Hirapur Works, P.O., Burnpur.**

- Singh, T. C. N.**, M.Sc., D.Sc., F.B.S., Professor and Head of the Dept. of Botany, Annamalai University, Annamalai Nagar.
- Singhi, Narendra Singh**, M.Sc., B.L., M.L.A., 48, Gariahata Road, Singhi Park, Ballygunge, Calcutta 19.
- Sinha, A. R.**, C/o. Dept. of Commercial Intelligence & Statistics, India, 1, Council House Street, Calcutta.
- Sinha, A. S.**, Ph.D. (Lond.), Professor of Physiology, Darbhanga Medical College, Post:—Laheriasarai, O. T. R.
- Sinha, B. K.**, Entomologist, Bihar, Sabour (Bhagalpore).
- Sinha, B. N.**, M.Sc. (Cantab.), Senior Marketing Officer & Chief Inspector of Weights, Bihar, Patna,
- Sinha, C. M.** C/o. The Scientific Instrument Co. Ltd., 6, Tej Bahadur Sapru Road, Allahabad.
- Sinha, Harish Chandra**, M.A., Ph.D., Dept. of Economics, Calcutta University, Calcutta.
- Sinha, M. S.**, D.Sc., Research Officer, Atomic Energy Commission, Govt. of India Bose Institute, 93, Upper Circular Road, Calcutta 9.
- Sinha, N. C.**, Engineer, Kassipur Co. Ltd. Dist. 24-Pargonas.
- Sinha, S.**, M.Sc., Ph.D., Psychology Department, University College of Science, 92, Upper Circular Road, Calcutta.
- Sinha, R. P.**, B.Sc., Ph.D., Principal, School of Mines & Applied Geology, Dhanbad.
- Sinha, T. N.**, Asst. Manager, M/S. A. H. Wheeler & Co., 18, Netaji Subhas Road, Calcutta 1.
- Sinha, Tarun Chandra**, M.Sc., Psychoanalyst, (Supt. Lumturi Park) Mental Hospital, 67, Jatin Das Road, Calcutta 29.
- Sircar, Ajit**, M.Sc., Prof. of Biology, City College, 8, Banerjee Lane, Calcutta 12.
- Sircar, J. P.**, M.B., Ch.B. (Edin.), Rose Research Institute, 93, Upper Circular Road, Calcutta.
- Sircar, S. K.**, M.Sc., Ph.D., A.R.S.M., D.I.C., Chemical Engineer, P. O. Kusunda, Manbhum.
- Sircar, S. M.**, M.Sc., (Cal.), Ph.D., (Lond.), D.I.C., Professor of Botany, Central College of Agriculture, Ananda Parbat, Delhi.
- Sirkar, S. C.**, D.Sc., F.N.I., Professor of Physics, Indian Association for the Cultivation of Science, 210, Bowbazar Street, Calcutta.
- Sitaraman, M. V.**, M.A., A.R.I.C., 24, Deivasigamani Mudali Street, Royapettah, Madras.
- Sitholey, R. V.**, Department of Botany, Lucknow University, Lucknow.
- Sivaraman, A.**, In-Charge, Scientific Department, Martin & Harris Co. Ltd., Savoy Chamber, Wallace Street, Bombay 1.
- Sohnle, (Mrs.) Kamala**, M.Sc. (Bom.), Ph.D. (Cantab), Amar Chandra Mansion, Mayo Road, Bombay.
- Som, Anil Bhusan**, M.Sc., Chemistry Department, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Sondhi, Ved Pall**, M.B.E., M.Sc., F.G.S., Geological Survey of India, 27, Chowringhee, Calcutta.
- Soman, (Dr.) S. W.**, Asst. Director, Haffkine Institute, Parel, Bombay 12.
- Soni, (Miss.) Padmini**, M.Sc., Central Laboratories for Scientific & Industrial Research, Jamai-Osmania, Hyderabad-Deccan.
- Soni, (Miss.) Padmini**, Research Scholar, Central Laboratories, Hyderabad-Deccan, Wyhgate, Simla 4.
- Soparkar, K. M.**, Capt., M.D., F.C.P.S., Military Hospital, Poona 1.
- Soparkar, M. B.**, M.D., F.C.P.S., A.M.E., F.N.I., Military Hospital, Poona 1.
- Sopory, S. N.**, Manager, Cement Marketing Co. of India Ltd., Bombay Mutual Building, Royal Exchange Place, Ext., Calcutta.

- Soundara Rajan**, K. V., M.A., Government Scholar, Dept. of Archaeology, Southern Circle, Madras 9.
- Souza**, A. De, B.A., B.E., A.M. Inst., C.E., A.M.I. Struct. E., A.M.I.E., Professor of Engineering, College of Engineering, Poona 5.
- Sreemani**, Bijoy Narayan, 15/1, Mohendra Sreemani Street, Calcutta.
- Sreemani**, Nando Lal, 15/1, Mohendra Sreemani Street, Calcutta.
- Sree Hanuman Sugar Mills Ltd.**, 178, Harrison Road, Calcutta.
- Sreenivasalah**, B. N., M.Sc., F.A.Sc., Director, Regional Meteorological Centre, New Colony, Nagpur.
- Sreenivasan**, A., D.Sc., F.R.I.C., Dept. of Chemical Technology, University of Bombay, Bombay 19.
- Srikantaya**, S., B.A., B.L., Cenotaph Road, Bangalore 2.
- Srinivasan**, K. S., Curator, Industrial Section, Indian Museum, 1, Sudder Street, Calcutta 13.
- Srinivasan**, M.N., Faculty of Arts, Baroda College, Sayajiganj, Baroda.
- Srinivasan**, R., B.Sc. (Hon.), Hydrologist, Madras Government Fisheries, Fresh Water Biological Research Station, 95, Poonamallee High Road, Kilpauk, Madras 10.
- Srivastava**, B. N., D.Sc., F.N.I., Reader, Dept. of Physics, Lucknow University, Lucknow.
- Srivastava**, (Dr.) D. L. Asst Director, Central Drugs Research Institute, Chattar Manzil Place, Lucknow.
- Srivastava**, Harish Chandra, M.Sc., Research Assistant, Indian Institute of Sugar Technology, Kanpur.
- Srivastava**, H. D., M.Sc., D.Sc., Research Officer, Indian Veterinary Research, Institute, Izatnagar.
- Srivastava**, Hari Mohan Lal, M.Sc., Assoc. I.A.R.I., Entomologist, Malariology, Govt. of U. P., Lucknow.
- Srivastava**, L. N., M.Sc., Lecturer in Chemistry, Lucknow University, Lucknow.
- Srivastava**, R. N., B.Sc., (Hon.) F.G.M.S., Geological Asst. Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Statistics Officer**, Vindhya Pradesh, Rewa.
- Subramanyam**, K., N.I.S., Research Fellow, Department of Botany, Central College, Bangalore 1.
- Subramanyam**, V., Geologist, Geological Survey of India, 4/5, D'Silva Road, Mylapore, Madras.
- Subrahmanyan**, V., D.Sc., F.I.C., F.N.I., Director Central Food Technological Research Institute, Cheluvamba Mansion, V. V. Mohl Mysore.
- Subrahmanian**, (Dr.) T. S., Superintendent, Development Laboratory, P. B. 127, Kanpur.
- Sud**, Baldev Chand, Chief Development Research Chemist, M/s. Shalimar Tar Products Ltd., Lodna, Jharia.
- Sukhatme**, P. V., Ph.D., D.Sc., (Lond.), F.N.I., Statistical Adviser, Indian Agricultural Research Institute, New Delhi.
- Superintendent** of Development Military Explosives, Kirkee.
- Sur**, M. M., Sur Enamel & Stamping Works Ltd., 9, Middle Road, Entally, Calcutta.
- Suratkar**, Tulsidas Shankar, M.Sc., Professor & Head of the Department of Chemistry, Mulund, N. T. College, Bombay.
- Standard Vacuum Oil Co. Ltd.**, 6, Church Lane, Calcutta 1.
- Swami**, Purushottama Dassa, M.Sc. (Chem.), F.I.C.S., M.S. (O.S.), Enamel Technologist, Tej Enamel & Metal Works, Gangoh Road, Saharanpur, U.P.

- Swaminathan, B.**, Applied Science Dept. The School of Military Engineering, Kirkee, Poona 3.
- Swaroop, S.**, M.A., C/o. Post Master, G. P. O., Calcutta.
- Swarup, D.**, Ph.D., (Sheffield), A.I.C., M.I.M., M.I. & S.I., M. M.G.I., Principal, College of Mining and Metallurgy, Benares Hindu University, Benares.
- Swarup, Shanti**, Professor of Botany, Jaswanta College, Jodhpur.
- Syam Choudhury, Nirupam Kumar**, Asst. Anthropologist, Dept. of Anthropology, Indian Museum, Calcutta.

T

- Talwalkar, Trymbak Waman**, M.S., Ceramic Engineer, University of Illinois, Ceramist, Tata Iron & Steel Co. Ltd., 8, Bagmati Road, Jamshedpur.
- Tambe, G. C.**, B.A.g., Sewage Farm Superintendent, 34, South Tukoganj, Indore, C.I.
- Tamhane, R. V.**, Ph.D., Soil Survey Officer, Indian Agricultural Research Institute, New Delhi.
- Tandon, (Dr.) R. N.**, Lecturer in Botany, University of Allahabad, Allahabad.
- Tangree, Hosang K.**, C/o. M/s. Hoshang Tangree & Co., 32, Ezra Street, Calcutta.
- Tangree, K. H.**, C/o. M/s. Hoshang Tangree & Co., 32, Ezra Street, Calcutta.
- Tangree, Khurshed K.**, B.Com., C/o. M/s. Hoshang Tangree & Co., 32, Ezra Street, Calcutta.
- *Tapadar, D. C.**, M.Sc., A.R.I.C., M.I.I., Chem.E., Chief Chemist, Indian Paper Pulp Co., P.O. Hazinagar, Naihati.
- †Tata Chemicals Ltd.**, Mithapur, Okhamandal, Kathiawad.
- Tata Oil Mills Company Ltd.**, Tatapuram, Cochin State.
- Tawde, N. R.**, B.A., (Hons.), M.Sc. (Bom.), Ph.D. (Lond.), F.Inst.P., F.A.Sc., F.N.I., Professor of Physics, Spectroscopic Laboratories, Indian Institute of Science, Mayo Road, Bombay.
- Tewari, B. D.**, C/o. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta.
- Thacker, D. D.**, Dewan Bahadur, M.M.E., F.R.S.A. (Lond.), Honorary Magistrate (First Class), Colliery Owner, Pure Jharia Colliery, Jharia (Manbhum).
- Thacker, M.S.**, Director, Indian Institute of Science, Bangalore 3.
- Thacker, V. M.**, M.Sc., Ph.D., Research Asst. in Organic Chemistry, The Institute of Science, Mayo Road, Fort, Bombay.
- *Thakor V. M.**, M.Sc., Ph.D., The Institute of Science, Mayo Road, Research Assistant in Organic Chemistry, Fort, Bombay.
- Thakur, Ram Sinha**, D.Sc., (Lond), Ph.D., M.Sc., (Nagpur), Scientific Adviser General Staff Branch (G.S.W.), Army Head Quarter, 5, Raisina Road, New Delhi.
- Thakurta, J. Guha**, C/o. The Eastern Economist, 52, Queensway, New Delhi.
- Thanwani, Prof. V. D.**, Gauhati University, Gauhati, Assam.
- Thapar, G. S.**, M.Sc., Ph.D., Indian Council of Agricultural Research, Lucknow University, Lucknow.
- Tharakan, (Miss) S. P.**, National Physical Laboratory, Hill Side Road, New Delhi.
- The Indian Wood Products Co. Ltd.**, Chemical Manufacturers, 8, Clive St., Cal.
- Tiagi, B. D.**, Professor of Botany, Government College, Ajmer.
- *Tilak, B. D.**, B.Sc. (Tech.), Ph.D. (Bom.), D.Phil. (Oxon), Professor of Dyestuff Technology, Department of Chemical Technology, University of Bombay, Matunga, Bombay 19.
- Tiwari, (Dr.) R. D.**, Dept. of Chemistry, University of Allahabad, Allahabad.
- Tiwary, N. K.**, M.Sc., Botany Department, Benares Hindu University, Benares.

- Travancore**, Rayons Ltd., The, United Indian Life Building, Esplanade, Madras.
- Tribedi**, B. P., M.B. (Cal.), D.B. (Lond.), F.N.I., Professor of Pathology, Medical College and Bacteriologist to the Government of West Bengal, Calcutta.
- Trivedi**, G. K., M.Sc., B.T., Demonstrator in Physics, Baroda College, Baroda.
- Trivedi**, Harbhai, President, Home School, Bhavanagar.
- Toshniwal**, B. D., M.Sc., S.M. (M.I.T.), Assoc. Mem. I.R.E., C/o. Toshniwal Bros. Ltd., Lady Jamshedji Road, Bombay 16.
- Toshniwal**, G. R., D.Sc., S.M.I.R.E., F.N.I., C/o. Toshniwal & Bros. Limited, Lady Jamshedji Road, Bombay 16.

U

- Ukil**, A. C., M.B., (Cal.), M.S.P.E., (Paris), F.S.M.F.B., F.N.I., Formerly Principal, Calcutta Medical College Hospital, 67, Dharamtala Street, Calcutta.
- Ullah**, S. Anwar, Ph.D., A.R.I.C., Principal, Bihar Agricultural College, Sabour P. O. Dist, Bhagalpore.
- Under Secretary**, Ministry of Food & Agriculture (Food), Jamnagar House, Mansingh Road, New Delhi.
- UNESCO**, Science Co-operation Office for South Asia, University Buildings, Delhi.

V

- Vachhani**, (Dr.) Moti V., Agronomist, Central Rice Research Institute, Cuttack, Orissa.
- Vad**, B. G., M.D., Consulting Physician, Peerbhoy Mansions, Sandhurst Road, Girgaun, Bombay 4.
- Vaheguddin**, (Dr.) Sayed, Plant Pathologist to the Government, Main Agriculture Farm, Himayat Sagar, Hyderabad, Deccan.
- Vaidya** P. C., P/9, Vallabh Vilyanagar, Via: Anand.
- Vaidyeswaram**, R., Research Scholar, Central Laboratories, Adigmet, Jamai-Osmania P. O., Hyderabad-Deccan.
- Vardan**, V. K. S., A.I.S.M., A.R.S.M., B.Sc. (Special) Lond., Geological Survey of India, 27, Chowringhee, Calcutta.
- Varma**, P. S., M.Sc., A.I.I.Sc., Professor of Organic Chemistry, Hindu University, Benares.
- Varman**, I. S., B.Sc., A.M.T.I. (Lond.), M.A.E., A.M.I.P.E. (Lond.), Mechanical & Electrical Engineer, 86, Ramnath Dass Road, Dhakuria P. O., Calcutta 31.
- Vasudeva**, R. S., Head of the Division of Mycology & Plant Pathology, Indian Agricultural Research Institute, Bunglow No. 1, New Delhi.
- Venkata**, M. P., Professor, A-10-734, Himayatnagar, Hyderabad-Deccan.
- Venkatachari**, V. P. M.A., Ph.D. (Lond.), D.I.C., Prof. & Head of Dept. of Mathematics, Osmania University, Hyderabad, Deccan.
- Venkataraman**, K., D.Sc., F.I.C., A.M.I.Chem.E., Mody Professor and Director of the Department of Chemical Technology, Bombay University, Matunga Road, Bombay 19.
- Venkataraman**, Sir T. S., Kt., C.I.E., D.Sc., 56, Thyagraja Road, Thyagarayanagar, Madras 17.
- Venkatarayudu**, (Dr.) T., M.A., Ph.D., F.A.Sc., Reader in Mathematical Physics, Andhra University, Waltair

- Venkatesachar**, B., Rao Bahadur, M.A., Professor of Physics, Central College, Bangalore 1.
- Venkateswaran**, C.S., Prof. of Physics, University College, Trivandram.
- Venkiteshwaran**, S. P., Meteorologist-in-Charge, Instruments & Supplies, Meteorological Office, Poona 5.
- Verma**, Brind, Behari, M.Sc., Research Scholar, University of Delhi, P. O. & Village, Hulesra, Via-Vasantpur, Saran.
- Verma**, Dinesh Chandra, B.Sc., C/o. Agricultural Machinery Manufacturing Corpn. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Verma**, Gyanendra, M.Sc., Vivekananda Laboratory, Almora.
- Verma**, H.C., C/o. Associated Instrument Manufactures (India) Ltd., B-5, Clive Building, Calcutta 1.
- Verma**, H. L., Principal, Government Technical Institute, C/o. Agricultural Machinery Manufacturing Corpn. Ltd., 38/1, Bose Para Lane, Baghbazar, Cal.
- Verma**, K. P., M.Sc., Senior Lecturer in Physics, Faculty of Science, M. S. University of Baroda, Baroda,
- Verma**, Raghuji, M.Sc., F.G.M.S., Department of Geology, Ranchi College, Ranchi.
- Verma**, Satish Chandra, B.Sc., C/o. Agricultural Machinery Manufacturing Corpn. Ltd., 38-1, Bose Para Lane, Baghbazer, Calcutta.
- ***Vasugar**, J., 11, Safdarjang Road, New Delhi.
- Vijayaraghavacharya**, Sir T., K.B.E., Diwan Bahadur, F.N.I., "Riverside," Adyar, Madras.
- Visva Bharati**, Santiniketan, W. Bengal.
- Viswambharan**, K. R., B.A., B.E., Commissioner for the Advancement of Backward Communities, Trivandrum.
- Viswanath**, Dr. Principal, Government College, Hossiarpur, E. Punjab.
- Viswanath**, S. N., 3, Harbour Park, Waltair.
- Viswanathan**, P. S., Rao Sahib, Agricultural Engineer to Government of U. P., Agricultural Gardens, Nawabganj, Cawnpore.
- Vizirani**, T. G., Entomological Assistant, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta 12.

W

- Wadia**, D. N., M.A., D.Sc., F.G.S., F.R.A.S.B., F.N.I., Geological Adviser, Atomic Energy Commission, Govt. of India, 10, King George Avenue, New Delhi.
- Wadia**, (Mrs.) Meher D. N., B.A., B.T. (Bom.), C/o. Mr. D. N. Wadia, 10, King George Avenue, New Delhi.
- Walawalkar**, D. G., B.Ag., M.S., Department of Sugar Chemistry, Indian Institute of Sugar Technology, Nawabganj, Cawnpore.
- Walchandnagar** Industries Ltd., Walchandnagar, Poona.
- Walvakar**, B. R., M.Sc., Research Chemist, Tata Chemicals Ltd., Mithapur, Okhamanladi, Kathiawad.
- Watcha**, Fredoon S., Mining Engineer, Agent, Tata's Sijua Group of Collieries, P. O., Sijua (Manbhum).
- †**West**, W. D., M.A. (Cantab), Sc.D., F.N.I., Bengal United Service Club, 29, Chowringhee, Calcutta.
- Western** Electric & Scientific Works, Nicholson Road, Near Nigar Talkies, Ambala Cantt.
- Wolsky**, Prof. Alexander, Principal, Scientific Officer, UNESCO Science Co-operation Office for South Asia, University Buildings, Delhi.

Y

- Yajnik**, N. A., M.A., D.Sc., A.R.I.C., F.N.I., 17, Manchubhai Rd., Malad, Bombay.
Yeddanapalli, Rev. Lourdu S.J., Ph.D., (Princeton), D.Sc., (Lourain), M.A., Head
of the Department of Chemistry, Loyola College, Cathedral, P.O., Madras 6.
Yin, Hung Chang, Field Science Officer, UNESCO Science Co-operation Office, University Buildings, Delhi.

Z

- Zaheer**, Dr. S. H., Director, Central Laboratories for Scientific & Industrial Research,
Jamai-Osmania P. O., Hyderabad-Deccan.
Zoological Survey of India, The Director, 34, Chittaranjan Avenue, Calcutta 12.

APPENDIX

- Banerjee**, Bhupati Kumar, M.Sc., Research Worker, Indian Association for the
Cultivation of Science, 210, Bowbazar Street, Calcutta.
-

LIST OF FULL SESSION MEMBERS 1951-52

A

- Achari, G., Ph.D., Professor of Pharmacology and Therapeutics, Medical College, Patna 4.
- Adam, John H., B.Sc. (Econ.) (Lond.), Managing Director, Orient Longman's Ltd., 17, Chittaranjan Avenue, Calcutta.
- Adyar S. K., Mansfield Oil Gas Co., Ltd., Calcutta 13.
- Adhya, J. K., 3/3, Ashutosh Seal Lane, Calcutta.
- Agarwalla, B., 70, Chowringhee Centre, Calcutta.
- Agarwal, Hariprasad, C/o. Bengal Standard Supply Agencies, 203-1, Harrison Road, Calcutta 7.
- Agarwala, S. B. D., B.Sc. (Hons.), B.Sc. (Agric.), Ph.D. (Lond.), Entomologist, Central Sugarcane Research and Development, Pussa, O. T. Rly.
- Agny, M.P.S., College of Engineering Hostel, Jadabpur.
- Ali, M. Bandey, Lecturer, Geology. M. V. Aligarh, U.P.
- Ali, S.B., Dept. of Biology, Dacca University, Dacca.
- Alam, S.M., Zoology Department, Muslim University, Aligarh.
- Ali, Syed Mehdi, Dept. of Zoology, Osmania University, Hyderabad-Deccan.
- Anantaraman, K.S., I.C.S., Director of Fisheries, Madras.
- Anant, P., Tata Iron & Steel Co. Ltd.,
- Anandavalli, (Miss) C. M., M.A., C/o. C. G. G. Panicker, Esqr., Resident Consultant, Tata Chemicals Ltd., Mithapur.
- Aiyar, T. V. Ramchandra, B.A., Retd. Metallurgist, 63-1, Govindappa Rd., Bangalore 4.
- Aran, (Miss) Sau Ayadden, C/o. R. Chakravorty, 27-2, Dikesu Lane, Calcutta.
- Ariya, B. Dasannach, University Prof. of Physics, University, Banaras.
- Ashthana, R. P., M.Sc., M.M.I.E., M.A.S.M.E., Chief Engineer, India Electric Works Ltd., 25, Dr. Suresh Sarkar Road, Calcutta.
- Athavale, Prof. N. M., Works Manager, Laboratory Apparatus Works, Poona.
- Auluck, F. C., D.Sc., F.N.I., Reader in Physics, Delhi University, Delhi.

B

- Badami, M. C., Chemistry Section, Indian Dairy Research Institute, Bangalore 1.
- Bakshi, Bimal Kumar, M.Sc., Ph.D., Forest Research Institute, New Forest, Dehra Dun.
- Balasubramanian, A., M.B., Junior Medical Asst., Pasteur Institute, Coonoor.
- Balasubramanian, R., Cotton Extension Officer, Lawbey Road, P.O. Coimbatore,
- Bansal, Vidyasagar, C/o. Ganga Glass Works Ltd., Balwall, E.I.R.
- Bandyopadhyay, K. S., M.A., D.Phil., Deputy Director, Industrial Statistical Branch, State Statistical Branch, P-18, B. K. Pal Avenue, Calcutta 5.
- Bandopadhyay, (Mrs.) Sushama, C/o. Dr. G. Bandopadhyay, Indian Institute of West Hill P.O., Calicut 5.

- Basak, N. G., M.Sc., Senior Scientific Officer, Fuel Research Institute, Jealgorah P.O., Manbhum.
- Banerjee, P. C.,
- Banerjee, P. R., 28-2B, Nakuleswar Bhattacharji Lane, Calcutta 26.
- Banerjee, K. B., C/o. M/s. Adair Dutt & Co., Limited.
- Banerjee, S. N., Ph.D., Botany Dept., Science College, Calcutta.
- Banerjee, Gautam Gunanda, 10, Rawdon Street, Calcutta.
- Banerjee, Sasankabhusan, Superintendent, Testing Department, Technical Research Laboratory.
- Banerjee, R., 124/3, Russa Road, Calcutta 16.
- Banerjee, B. K., 13, Kabir Road, Calcutta 26.
- Banerjee, S. K., Rishi Bankim College, Naihati.
- Banerjee, G., Assam Bengal Cement Co. Ltd.,
- Banerjee, G. K., Assam Bengal Cement Co. Ltd.,
- Banerjee, T. N., 6, Hastings Street, Calcutta.
- Banerjee, B. B., 7-1, Nafar Kundu Lane, Calcutta.
- Banerjee, Dhirendra Nath, Calcutta.
- Banerjee, P. C., 8, Lyons Range, Calcutta.
- Banerjee, (Capt.) B., M.Sc., M.B., Asst. Professor of Physiology, Assam Medical College, Dibrugarh.
- Banerjee, G. N., C/o. Gansons Ltd., Post Box No. 5576, Bombay 14.
- Banerjee, J. C., Senior Scientific Officer, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
- Banerjee, N. R., Asst. Superintendent, Department of Archeology, Southern Circle, Madras 9.
- Banerjee, S. B., B.Sc., Manager, Scientific Instrument Co., Ltd., 29, Regal Buildings, Parliament Road, Connaught Place, New Delhi.
- Banerjee, B. K., Defence Science Organisation, Hill Side Road, New Delhi 5.
- Banerjee, S. M., M.Sc., Asst. Research Officer, Central Inland Fisheries Research Institute, Cuttack 1.
- Banerji, (Mrs.) Setabji, 19A, Palit Street, Calcutta.
- Banerji, P. K., 28, Gangaprasad Mukerjee Road, Calcutta 25.
- Banerji, Sudhir Kumar, Professor of Biology, Scottish Church College, Calcutta 6.
- Banerji, R. B., M.Sc., Research Training Scholar, 19A, Palit Street, Calcutta 19.
- Bardhan, U. C., Vidyasagar College, 39, Sankar Ghosh Lane, Calcutta.
- Barua, Arun Kumar, C/o. Late Prof. B. M. Barua, 49-1, Baldeopara Road, Manicktala, Calcutta 6.
- Barua, S. K., Director of Geology and Mining, Govt. of Madhya Pradesh, Nagpur.
- Baruah, H. K., M.Sc., Ph.D., F.L.S., Head of the Dept. of Botany, Gauhati University, Gauhati.
- Barman, J. N., M.Sc., A.R.I.C., M.M.G.I., Hirapur Works Laboratory, Burnpur P.O., Burdwan.
- Bashore, Y. Amunalal, Superintendent of Census Operation, Rajasthan, Udaipur.
- Basu, K., 1-1, Satyendra Dutt Road, Calcutta-29.
- Basu, A.K., D.22, Govt. Housing State, Calcutta-14.
- Basu, Sunil Chandra, 10, Kalidas Singha Lane, Calcutta 9.
- Basu, Rabindra Krishna, 7, Mohanlal Street, Calcutta 4.
- Basu, A. N., M.Sc., Senior Scientific Officer, Fuel Research Institute, Jealgorah P.O., Manbhum.
- Basu, Asutosh, B.Sc., M.B., 68-4, Lakshman Das Lane, Howrah.
- Basu, B. K., Esqr, I.C.S. (Retd.), Member, Viswa Bharati Executive Council, 10, Ashu Biswas Road, Bhowanipur, Calcutta 25.

- Basu, Durgadas, Statistical Officer, Directorate of Agriculture Govt. of West Bengal, Writers Buildings, Calcutta 1.
- Basu, Jagadindra Nath, Electrical Contractor, C.P.W.D., 45, Golf Club Road, Tollygunge, Calcutta 33.
- Basu, (Mrs.) N. M., C/o. Prof. N. M. Basu, 7, University Road, Aligarh.
- Basu, Sarat Kumar, M.Sc., Asst. Chemical Examiner, to the Govt. of West Bengal, Chemical Dept. Medical College, Calcutta.
- Basu Roy Choudhury, Bhupendra Chandra, Chief Chemist, Loyobad Coke Plant, Bansjorah P.O., Manbhum.
- Balachandra, T.,
- Balacvar,
- Badami, S.B., 136B, Rashbehari Avenue, Calcutta.
- Bairn, Fair, Bengal Engineering College, Botanic Garden, Howrah.
- Batra, Shanti, 12, Mandeville Gardens, Calcutta 19.
- Bejawa, Haris Chandra, Asst. Director, National Chemical Laboratory, Poona
- Bera, Binoyendra K., 43-2A, Subarban School Road, Calcutta 25.
- Bhat, P. V., Poona-4.
- Bharadvaj, C.P., Prof. of Geography, Punjab University, C/o. Govt. College, Bhattacharya, S. N., Ewing Christian College, Allahabad.
- Bhattacharya, Subrota, Harighata.
- Bhatte, P.K., 30, Kali Krishna Tagore St., Calcutta-7.
- Bhar, H. G., M/s. Adair Dutt & Co., Limited.
- Bhagat, Satindramohan, 10, Canning Street, Calcutta 1.
- Bhaduri, Dayananda, Lecturer in Chemistry, Presidency College, Calcutta.
- Bhaduri, S. R., B.Sc., B.E., C/o. S. R. Dutt, Esqr., S.D.O., M.E.S., Allahabad.
- Bhagwat, G. A., M.D., B.Sc., B.M.S., Superintendent, Central Mental Hospital, Yeravada, Poona 6.
- Bhandari, L. C., M.A., Ph.D. (Lond.), A.M.B.P.A.S. (Lond.), A.B.P.S. (Lond.), Psycho-Analyst, 32, Purnavila Road, New Delhi.
- Bhandarkar, Raghunandan Shamvao, Asst. Educational Adviser (Tech.), 5, Esplanade East, Calcutta.
- Bhar, Chandranath, Dept. of Chemistry, Chandernagor College, Chandernagor.
- Bhar, G. D., M.Sc., P.R.S., Professor of Mathematics, Presidency College, Calcutta.
- Bhargava, Shri, C/o. Mr. K. P. Shukla, Soil, Laboratory Irrigation Research Laboratory, Bahadrabad, Uttar Pradesh.
- Bharucha, F. R., Institute of Science, Fort, Bombay 1.
- Bhattacharyya, Asitesh, 34, Beresford Road, Kirkee, Poona 3.
- Bhattacharya, Ajoy Sankar, C/o. The Balance Works, D35-68, Jangambari, Banaras.
- Bhattacharya, (Dr.) B. K., Chemical, Industrial & Pharmaceutical Laboratories Ltd., 289, Bellasis Road, Byculla, Bombay 8.
- Bhattacharjee, (Miss) Dipti, Botany Dept., University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Bhattacharya, (Dr.) P. C., 7-A, Birchand Goswami Lane, Calcutta 5.
- Bhattacharya, S., I.O.S., Asst. Works Manager (Production), Gun & Shell Factory, Cossipur.
- Bhattacharyya, S. C., Senior Scientific, National Physical Laboratory, Poona 7.
- Bhattacharyya, S. K., D.Sc., F.R.I.C., Asst. Professor of Physical Chemistry, and Head of the General Chemistry Dept., Indian Institute of Science, Malle-swaram, Bangalore 3.
- Bhattacharya, S. K., B.Sc., A.M.C.E., A.M.I.St.E., Asst. Executive Engineer, Port of Calcutta, 51, Circular Garden Reach Road, Kidderpore, Calcutta 23.
- Bhattacharya, Sachchidananda, Reader in History, Gauhati University, University Colony, Tribune P.O., Gauhati.

- Bhattacharjee, Sunil Kumar, Lecturer in Biology, Presidency College, Calcutta.
 Bhavanani.
- Bhiday, M. R., Lecturer, Dept. of Physics, College of Science, Nagpur.
- Bhilmachar, B. S., D.Sc., F.N.I., Central Marine Fisheries Research Station, West Hill P.O., Calicut 5.
- Bhimasenachar, J., D.Sc., Reader in Physics, Andhra University, Waltair.
- Bhoumik, A.K., 4, Hastings Street, Calcutta.
- Bhose, Sudhir Kumar, M.Sc., LL.B., Advocate High Court, 24-A. Ray Bagan Street, Calcutta 6.
- Bhuyan, H. C., M.Sc., Ph.D., Professor of Physics, Uzanbazer, Gauhati.
- Bhuyan, (Dr.) Manish Chandra, R. G. Kar Medical Hostel, 1, Belgachia Road, Calcutta 4.
- Biswas, Manindralal, M.B., M.R.C.S., etc., 11B, Indian Mirror Street, Calcutta 13.
- Biswas, P., C/o. Messrs. B. Biswas & Co.
- Biswas, J. N., Chemist, Assam Oil Co., Digboi.
- Biswas, (Miss) Amita, C/o. Dr. K. Biswas, D.Sc., F.N.I., Superintendent, Indian Botanic Garden, Botanic Garden P.O., Howrah.
- Biswas, Arun Kumar, 69-B, Townshend Road, Calcutta 26.
- Biswas, Sanat, B.E. (Marine Engg.), C/o. Dr. K. Biswas, D.Sc., F.N.I., Superintendent, Indian Botanic Garden, Botanic Garden P.O., Howrah.
- Biswas, (Mrs.) Saraju, C/o. Dr. K. Biswas, D.Sc., F.N.I., Superintendent, Indian Botanic Garden, Botanic Garden P.O., Howrah.
- Biswas, Sudhir Kumar, C/o. S. K. Biswas & Co., 137, Bowbazar Street, Koley Buildings, Calcutta.
- Bose, Nalini, 92-3, Upper Circular Road, Calcutta 9.
- Bose, P. K., 35, Ballygunge Circular Road, Science College, Calcutta University.
- Bose, Sunil, 65, Bagbazar Street, Calcutta.
- Bose, Monojmohon, 17, Duff Street, Calcutta.
- Bose, S., M.B., 32A, Dharmatola Street, Calcutta.
- Bose, D. N., 26/1A, Sarkar Lane, Calcutta.
- Bose, A. K., 161, South Park, Jamsedpore,
- Bose, R.K., 161, South Park, Jamshedpur.
- Bose, I.B., D.Phil. (Berlin), 2, Chatterjee Lane, Calcutta 12.
- Bose, J. L., M.Sc. Junior Scientific Officer, National Chemical Laboratory, Poona.
- Bose, Jagannath, C/o. Sri Manmohan Talukder, Fancy Bazar, Gauhati.
- Bose, Ganendra Chandra. Electrical Engineer, 16-1, Shama Charan Dey St., Calcutta.
- Bose, (Mrs.) Pramila, M.Sc., Botany Department, Bethune College, Calcutta.
- Bose, S. K. Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Bose, Samir Kumar, 45, Amherst Street. Calcutta 9.
- Boaz, (Dr.) G. D., Dept. of Geography, University of Madras, Madras.
- Brijmohon, Benaras Hindu University, Benaras.
- Buchi, (Dr.) Ernst C., Superintendent, Dept. of Anthropology, 27, Chowringhee, Indian Museum, Calcutta 13.

C

- Cattanach, A. B., B.Sc., M.P.S., Ph.C., Works Manager & Director, Smith Stanistreat Co., Ltd., 18, Convent Road, Calcutta 14.
- Charan, (Dr.) R., D.Sc., Professor of Glass Technology, and Head of the Glass Tech. Dept., Benares Hindu University, Banaras.
- Charan, Shyama, Ph.D., Victoria College, Gwalior.
- Char, T. L. Rama, M.Sc., Ph.D., Lecturer, Indian Institute of Science, Bangalore 3.
- Chaudhuri, A. K., Indian Institute of Technology, Kharagpur.

- Chaudhury, Mahendranath, 263, Upper Circular Road, Calcutta.
 Chaudhury, Anjali Sen, Presidency College.
 Chowdhury, K. N., 9, Ezra Street, Calcutta.
 Chaudhuri, Jyostna Kr.,
 Chaudhuri, Bimalendu, 14B, Park Side Road, Calcutta 26.
 Chaudhuri, (Dr. Miss) M., 28, Lady Hardinge Road, New Delhi.
 Chaudhuri, (Dr.) K. D., Medical College, Patna 4.
 Chaudhuri, Hiralal, M.Sc., Central Fisheries, Zobra, Cuttack 1.
 Chandy, C. C., B.A., Adair Dutt & Co. (India) Ltd., Mount Road, Madras.
 Chandra, (Miss) N., C/o. Mr. T. S. Padmanabhan, 'Gopu Nivas,' Nageshwarapuram, Mylapur, Madras.
 Chanda, M. S., C/o. Burma Lime & Chemical Works, 5, Clive Ghat Street Calcutta.
 Chandrasekhar, G. R., M.Sc., 69-A, Mrovi Hostel, Banaras Hindu University, Banaras.
 Chakravorti, A. K., I. C. I. Research Fellow, Botany Dept., University College of Science, 35, Ballygunge Circular Road, Calcutta.
 Dixon Lane, Calcutta 14.
 Chakravarti, (Dr. Miss) D., D.Phil. (Oxon.), Professor of Chemistry Bethune College, Calcutta.
 Chakravarti, S. C., 97, Keshab Sen Street, Calcutta.
 Chakravarti, B. N., C/o. M/s. Adair Dutt & Co., Limited.
 Chakravarti, Gita, 5-2, Madhab Chatterjee Lane, Calcutta 20.
 Chakravarti, Tilottama, Harighata.
 Chakravarti, M.N., Nain Drainage Dept., Calcutta Corporation.
 Chakravarty, M., Bangabashi College, Calcutta.
 Chakraborty, M.M., 92, Upper Circular Road, Calcutta.
 Chakraborty, 8, Hindusthan Road, Calcutta.
 Chakraborty, (Miss) Preati, M.A., Lecturer in Charge, Botany Dept. Asansole Girls College, Asansole.
 Chakravarty, A. P., M.B., House Surgeon, Eden Hospital, Medical College, 27-2, Chatterjee, Anil Chandra, B.Sc., 22, Satkari Mitra Lane, Calcutta 11.
 Chatterjee, (Dr.) Anupam, Naxulbari P.O., Darjeeling.
 Chatterjee, B. K., Sugar Technologist, Oliver Doss (India) Ltd., 71, Chetla Road, Calcutta 27.
 Chatterjee, (Mrs.) B. K., Oliver Doss (India) Ltd., 71, Chetla Road, Calcutta 27.
 Chatterjee, Bamandas, M.Sc., Development, Laboratory in charge, of Hindusthan General Electric Company, Radio Factory, Karampura, Nirshachatti P.O., Manbhum.
 Chatterjee, D., 519-A, College Road, Matunga, Bombay 19.
 Chatterjee, (Dr.) Kaliranjana, Asst. Research Officer, I.C.M.R., School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
 Chatterjee, (Miss) Kalyani, 8-1B, Chakraberia Road, South, Calcutta 25.
 Chatterjee, (Dr.) Manomohan, Head of the Department of Geology, Presidency College, Calcutta.
 Chatterjee, Nirmal Chandra, M.A., Dept. of Geography, Presidency College, Calcutta.
 Chatterjee, Nisith Ranjan, M.Sc., 89-B, Raja Dinendra Street, Calcutta.
 Chatterjee, S. N., M.B., D.T.M., Asst. Research Worker, Leprosy Dept., School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
 Chatterjee, N. G., C/o. N. R. Sarkar & Co. Ltd., Calcutta.
 Chatterjee, U. N., Ed. & Dy. Director (Publicity), Jamnagar House, Mansingha Rd., New Delhi.
 Chatterjee, Santigopal, Rishi Bankim Chandra College, Naihati, 24-Parganas.
 Chatterjee, J. K., M/s. Adair Dutt & Co., Limited.

- Chatterjee, B.C., 12-A, Ramratan Bose Road, Calcutta.
 Chatterjee, S. K., Hindusthan Scientific Works, Benaras.
 Chatterjee, T. D., 10, Preonath Banerjee Street, Calcutta 9.
 Chatterjee, S. D., 91, Ballygunj Place, Calcutta 19.
 Chatterjee, R.N., 36, Ritchie Road, Calcutta.
 Chatterji, S. R., B.Sc., B.L., Manager, Scientific Instrument Co., Ltd., 29, Regal Buildings, Parliament Road, Connaught Place, New Delhi.
 Chatterji, L. D., Mathematics Dept., Allahabad University, Allahabad.
 Chacko, K. Jesoph, Divisional Statistical Officer, Bombay State Transport.
 Chand, Seth Phul, Dwadash Shuni, Governing Director, P. C. Dwadash Shuni & Co. Ltd.
 Chandra, A. K., India Paint Colour & Varnish Co. Ltd., 14, Netaji Subhas Road, Calcutta.
 Chari, K.S., Dept. Chem. Tech., Osmania University.
 Chintapanth, 136B, Rashbehari Avenue, Calcutta.
 Chief Research Officer, Central Inland Fisheries Research Inst. Barrackpore, Calcutta.
 Chidambaram, K., Dy. Director of Fisheries, 141, Mowharji Road, Royapettam, Madras.
 Chowdhury, A. K., 4-B. Jainaddi Mistry Lane, Alipore, Calcutta 27.
 Chowdhury, Dhisnadhi, 40, Chowdhury Para, Santragachi P.O., Hawrah.
 Choudhury, Jamini Mohan, Lecturer-in-Charge, Geology Department, Gauhati University, Gauhati.
 Chaudhury, Jamuneswar, M.Sc., 223, Chittaranjan Avenue, Calcutta 6.
 Chowdhury, (Miss) Kamala. M.A., Ph.D., Head of the Psychology Division, The Ahmedabad Textile Industries Research Association, Post Box No. 170, Navarangapura, Ahmedabad.
 Choudhury, Pijush Kanti, M.Sc., D.Phil., A.M.I.Ch.E., Lecturer, Applied Chemistry Dept., University College of Science, 92, Upper Circular Road, Calcutta 9.
 Choudhury, (Miss) Uma, M.Sc., Asst. Anthropologist, Anthropology Dept., Govt. of India, Indian Museum, 27, Chowringhee, Calcutta 13.
 Chobey, Bankim,
 Chowhan, J. S., Central Drug Laboratory,
 Church, John William Godsdon, D.F.H., A.M.I.E.E., M.I.E., Agent, Calcutta Electric Supply Corporation Ltd., Victoria House, Chowringhee Square, Calcutta.
 Correa, J. P., Information officer, University Buildings, New Delhi.
 Corbella, (Rev.) Jose M., S.J., M.Sc., L.D., Professor of Chemistry, St. Xavier's College, Cruick Shank Road, Bombay 1.

D

- Das, Anukul Ch., Indian Statistical Institute, Calcutta.
 Das-Gupta, A.C., 29A, Satish Mukherjee Road, Calcutta.
 Das Gupta, N. K., Bangabasi College.
 Das, Sideswar,
 Das Gupta, Debi Colony, Dum Dum.
 Das, Kumud Sarkar, Professor of Botany, Surendranath College, Rishra. (Mahes). Square, Calcutta.
 Das, Sunil Kumar, C/o. M/s. Adair Dutt & Co., Ltd., Stephen House, Dalhousie Calcutta.
 Das Gupta, Manindra Lal, 13-4B, Ram Kanto Bose Street, Calcutta 3.
 Das, B. M., Central Leather Research Institute, Guindy, Madras.

- Das Gupta, Tapash, R. G. Kar Medical College, Calcutta.
- Das, Bancsvaer, College of Engineering & Technology, Jadavpur.
- Das, Arati, 127, Raja Dinendra Narayan Street, Calcutta.
- Das, (Dr.) G. B., B.Sc., M.D., Director, Tropical Diet Research Society, 1-6, Fakir Chakrabarty Lane, Calcutta 6.
- Das, Kanailal, M.Sc., M.M.G.I., F.G.M.S., Geologist, 25, Abinash Banerjee Lane, Santragachi P.O., Howrah.
- Das, Nani Pada, M.Sc., Mycological Asst., 230, Netaji Subhas Road, Tollygunge, Calcutta 33.
- Das, P. M., M.Sc., Asst. Meteorologist, The Observatory, Lodi Road, New Delhi 3.
- Das, Provas Kumar, B.Sc., Dip.Agric.Sc. (India), Ph.D., Agriculture Development & Research Officer, E. M. Alcock & Mohhta Ltd., 19, British Indian Street, Calcutta.
- Das, Rabindra Nath, Professor of Physics, Cotton College, Gauhati.
- Das, S. R., M.Sc., Dept. of Anthropology, Govt. of India, Indian Museum, Calcutta 13.
- Das, Srimant Lal, B.Sc., Asst. Master, Patna High School, Anusabad P. O. Patna.
- Das, (Dr.) Saroj Kumar, M/67, Quarters, B.R. Singh Hospital, Sealdah, Calcutta 14.
- ing, Bihar College of Engineering, Mahendrum Pm.O., Patna 6.
- Das Gupta, A., B.Sc., Chemist, Mira Chemical Industries, 11A, Prince Anwar Shah Road, Calcutta 33.
- Das Gupta, A. K., Fuel Research Institute, Jealgorah P. O., Manbhum.
- Das Gupta, Bidhu Bhusan, 67/24, Strand Road, Nimtollah, Calcutta.
- Das Gupta, (Dr.) Debendra Chandra, Reader & Head of the Dept. of Education, Gauhati University, Gauhati.
- Das Gupta, J. C., M.Sc., Ph.D. (Lond), Director, Mira Chemical Industries, 11A, Prince Anwar Shah Road, Calcutta 33.
- Das Gupta, Jnanendra Chandra, M.A. Ph.D. (Dublin), Vice-Principal & Professor, Basic Training College, Banipur, 24-Pargonas.
- Das Gupta, S. S., M.Sc., C/o. Burmah Shell, Hongkong House, Post Box No. 360, Calcutta.
- Dash, U. N., M.B.B.S., Dept. of Physiology, Medical College, Cuttack.**
- Dastidar, N. N. G., B.Sc. (Tech), A.M.C.T., M.I.E., Professor of Mechanical Engineering.
- Datar, S. K., B.Sc., A.I.I.Sc., Factory Manager, The Bangalore Whitelead Syndicate Ltd., Konnagar P. O., Hooghly.
- Datta, N., Central Inland Fisheries, Barrackpore.
- Datt, P.C., 18, Madan Mitra Lane, Calcutta.
- Datta, (Mrs) Naline, Dept. Anthropology, Indian Museum, Calcutta.
- Datta, N.R., Soil Conservation Dept., D.V.C., Hazaribagh.
- Datta, (Dr.) N. P., Agronomist, Indian Agriculture Research Institute, New Delhi.
- Datta, R. L., M.Sc., D.I.C., Ph.D., Applied Science Dept., Delhi Polytechnic, Delhi.
- Datta, Ramani Ranjan, B. E. (Cal.), Asst. Engineer, Irrigation Dept. Govt. of West Bengal. 27/1, Kankulia Road, Ballygunge, Calcutta 19.
- Datta, S. C., D/20, Agricultural Research Institute, New Delhi 5.
- Dayal, Jagdeshwari, Dept. of Zoology, University of Lucknow, Lucknow.
- Deb (Jr.), S., Sambhūnath Pandit Street, Calcutta.
- Deb, A. R., M.Sc., Indian Association Cul. of Science, 2 & 3, Lady Wellington Road.
- De, Bimal Chandra.
- De, G., College of Military Engineering, Kirkee.
- De, P. N., Retd. Professore Science College, Patna, 'Nabinkuthi,' Bankipur, Patna.
- De, Rajat, M.Sc., U. P. Govt. Research Scholar, College of Agriculture, Banaras Hindu University, Banaras.

- De, S. C., M.Sc. (Pat.), M.A. (Cantab), Deputy Director of the Central Bureau of Economics & Statistics, Bihar, Patna Secretariat P. O., Patna 1.
- Dey, Upendra Nath, School of Tropical Medicine, Calcutta.
- Dey, Gour Mohan, 79, Gurpar Road, Calcutta 9.
- Dey, Haripada, B.Sc., C/o. Garrett, & Garrett, 2, Commercial Buildings, Netaji Subhas Road, Calcutta 1.
- Deo Ranganath R., Manager, The Paterson Engg. Co. (India) Ltd., 61, Lansdown Road, Calcutta 25.
- Deo, (Mrs.) Tarabai, 61, Lansdown Road, Calcutta 25.
- Desai (Dr.) A. D., Govt. Agricultural Chemist, Hymaytsagar, Hyderabad-Deccan.
- Despande, C.M., College of Engineering Hostel, Jadabpur.
- Desai, M.D., Physical Research Laboratory, Ahmedabad.
- Desikachan, R., 12, Dover Road, Calcutta 19.
- Desai, D. S., B.Engg. (Sheffield), M.I.E., Etc., Braithwaite & Co. (India) Ltd., Post Box No. 427, Calcutta.
- Dev, S. B., Tocklai Experimental Station, Cinnamara.
- Devi, (Mrs.) Anima, Dept. of Chemistry, Bethune College, Calcutta.
- Devi, (Miss) K. M. Sarada, B.Sc., C/o. C. G. G. Panicker Esqr., Residential Consultant, Tata Chemicals Ltd., Mithapur, (Samashtra Rly).
- Dewan, (Dr.) M. L., Ph.D., Soil Scientist, Land Use Planning and Reclamation, Damodar Valley Corporation, Hazaribagh.
- Dhayogode, S.T., Bombay Haffkine Institute, Bombay.
- Dhar, Samrendra K., Presidency College, Calcutta.
- Dharmendra, M. B. B. S., D.B. (Lond.), Officer-in-Charge, Leprosy Research Dept., School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Dhayagude, R. G., M.D., Dean, Seth G. S. Medical College, Parel, Bombay 12.
- Director, C/o. M/s. Murarka Paint & Varnish Works Ltd.,
- Dighe, S. G., Esqr., B.A., M.Sc., Superintendent, Assay Dept., India Government Mint, Fort, Bombay.
- Dinker, M. R., "Maharashtra Mandal," 'K' Road, Jamshedpur.
- Director of Agriculture Assam, Shillong.
- Director of National Museum, Ceylon.
- Dikshit, Vidyanand Kashinath, University Dept. of Chemical Technology, Matunga, Bombay 19.
- Drupa, H.V.K., Central Imperial Hotel, Central Avenue,
- Dryansagar, V. R., M.Sc., Head of the Dept. of Botany, College of Science, Raipur M.P.
- Dukh Haran. C/o. Toshniwal Bros Ltd., 4th Floor. Janmobhoomi Chambers Ballard Estate, Fort Street, Bombay 1.
- Dutta, Bijoy Prasad, M.Sc., Chemist Indian Drugs Laboratory, P/7, Belegkata Main Road, Canel Bridge, Calcutta 10.
- Dutta, Deva Prasad, 200, Southern Avenue, Calcutta 29.
- Dutta, (Sm.) Madhuri, Lecturer in Botany, Lady Brabourne College, P/12, Durga Road, Calcutta 17.
- Dutta, Mahadev, N. I. S. Research Fellow, Dept. of Physics, University College of Science, 92, Upper Circular Road, Calcutta.
- Dutta, P. B., Electrical Engineer, Tata Iron & Steel Co. Ltd., 65, 'P' Road, Jamshedpur.
- Dutta Choudhuri, R., B.Sc., M.B., Pathologist, Chittaranjan Cancer Hospital, Calcutta 26.
- Dutta, Alin K., Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta.
- Dutta, B.C., 18, Netaji Subhas Road, Calcutta-1.
- Dutta Gour, Ravi, Madhab College, Ujjain, Madhaya Pradesh.

- Dutta, Vishnu, Managing Director,
 Dutt, Asoke Gopal, 53, Ekdalia Road, Calcutta 19.
 Dutt, D. C., 4, Butto Kristo Lane, Calcutta 5.
 Dutt, Sachindra Bhusan,
 Dutt, Monoranjan, 4, Vidyasagar Street, Calcutta.
 Dutt, Mihir Kumar, Lecturer in Zoology, Dept. of Zoology, University of Delhi, Delhi 8.
 Dutt, (Prof) P., Dept. of Geology, Presidency College, Calcutta.
 Dutt, Pratibha Ranjan, M.B., D.P.H., Port Health Officer (Under the Ministry of Health, Govt. of India) Port Health Office, P/21, Mission Row Extn., Calcutta 13.
 Dutt, (Prof.) S. B., M.Sc., The Calcutta Technical School, 110, Surendra Nath Banerjee Road, Calcutta.
 Dutt, S. C., M.A.(Lond.), 11, Mohes Chowdhury Lane, Calcutta 25.
 Dutt, Sadhan C., C/o. Kuljian Corporation, 101, Park Street, Calcutta.

E

- Engineer, T. D., Esqr., B.E.E. (U.S.A.), A.I.E.E., 1, Beldih Lake, Jamshedpur.
 Evans, (Mrs) E., Great Eastern Hotel, Calcutta.

F

- Faruqi, A. J., M.Sc., Ph.D., D.I.C., F.Z.S., Fisheries Biologist, U.P., Lucknow.
 Fielder, Cecil John, General Manager, Shalimar Tar Products (1938), Ltd., 6, Lyons Range, Calcutta 1.
 Framji, K. K., 6, Esplanade East, Calcutta.

G

- Ganguli, N. C., Surendranath College, Calcutta.
 Ganguli, D. M., 2/2B, Nabin Kundu Lane, Calcutta
 Ganguli, Hirendra Nath, 21, Old Court House Street, Calcutta.
 Gadgil, Gobardhan Das, Desai & Co., Bombay.
 Gaiind, K. N., Medical College, Amritsar.
 Ganguli, P., 116, Panchanantola Road, Howrah.
 Ganpathy, S., Indian Chemical Manufacturing Association,
 Gananathan, V. S., Reader in Geography, University of Poona, Poona.
 Ganapati, (Dr.) P. N., Head of the Dept. of Zoology, Andhra University, Waltair.
 Ganguly, D., M.Sc., Ph.D. (Lond.), 21/1A, Fern Road, Calcutta 19.
 Gangal, D. D., M.Sc., General Manager, Lakasangraha Works, 624, Sadashiv, Poona 2.
 Ganguly, H. D., M.Sc., A.R.I.C., Chemical Department, Medical College, Calcutta.
 Ganguli, (Dr.), S. M., C/o. Prof. P. C. Sarbadhikar, 84, Ballygunge Place, Calcutta 19.
 George, (Dr.) J. C., Head of the Dept. of Zoology, M. S. University, of Baroda, Baroda.
 General Manager, M/s. H. P. Sugar Mills & Co., Ltd., Maghalla R. S., Champaran.
 Ghatak, Satyendra Mohan, Engineer-in-Charge, M/s. Bangasri Ice & Cold Storage Ltd., 13B, Free School Street, Calcutta.
 Ghose, Bhabesh, 20, Raja Naba Kristo Street, Calcutta.
 Ghose, Chinmoy, 27, Chowringhee, Calcutta 13.
 Ghose, Chitra, 63B, Lansdowne Road, Calcutta 25.

- Ghose, H. N., 214, Lower Circular Road, Calcutta.
- Ghose, Manindra Nath, 64, Raja Basanta Ray Road, Calcutta.
- Ghose, H., 10, Lake Avenue, Calcutta 26.
- Ghose, (Miss) Lalita, 35, Ballyganj Circular Road, Calcutta.
- Ghosh, Dharendra Nath, Chandernagar.
- Ghosh, A. B., Chemical Dept., Medical College.
- Ghosh, Parijat, M.A., B.T., 15, Jones Square, New Delhi.
- Ghosh, B. N., C/o. M/s. Adair Dutt & Co., Limited, Calcutta.
- Ghosh, B. K., Chemist, Provincial Drug Central Laboratory, School of Tropical Medicine, Calcutta 12.
- Ghosh, (Dr.) B. N., M.Sc., D.Phil., 23/1, Brindaban Bose Lane, Calcutta 6.
- Ghosh, Brajendra Nath, Professor of Physics, Presidency College, Calcutta.
- Ghosh, D., M/S. Wild Barfield Furnaces Ltd., &/B, Place, Calcutta.
- Ghosh, D. P., Wood Seassing Branch, Forest Research Institute, New Forest P. O., Dehra Dun.
- Ghosh, Jyotish Chandra, Secretary Nikhil Bharat Banga Bhasa Prochar Samity, 35/10, Pudda Pukur Road, Calcutta.
- Ghosh, Prafulla Chandra, B.Sc., B.Met., Dept. Chemistry C Metallurgy, Bengal Engineering College, Sibpore, Howrah.
- Ghosh, R. N., 152, South Malaba, Allahabad.
- Ghosh Rames Chandra, B. E., C.E., Asst. Engineer, Port of Calcutta 5-, Circular Garden Reach Road, Calcutta 23.
- Ghosh, S. B., B.Sc. (Chem.), Hons., B.Che. (Hons.), Chemical Engineer, 7, Bepin Pal Road, Calcutta 26.
- Ghosh, S. D., B.Sc., A.I.S.M., C/o. C. S. Ghosh, Esqr., Ikrah P. O., Burdwan.
- Ghosh, S. K., Asst. Meteriologist, Indian Meteriological Dept., Poona.
- Ghosh, S. K., B.Sc. (Hons.), F.R.G.S., 12, Air Survey Party, Survey of India, Shillong.
- Ghosh, (Miss) S. E. Rani, Principal, Gikhale Memorial Girls School & College, 8, Baneapukur Road, Entaly P. O., Calcutta.
- Ghosh, (Miss) Sandhya, Lecturer in Physics, Women's College, Aligarh.
- Ghosh, (Miss.) Shila, Dept. of Botany, Gauhati University, Gauhati.
- Ghosh, (Miss) Sova, M.B., 12/1/1A, Grove Lane, Calcutta 26.
- Ghosh, Sudhir Kumar, M.Sc., Lecturer in Physics, Chandernagar College, Chandernagar P. O., Hooghly.
- Ghosh, (Miss) Suhasi, M.A., B.T., Ph.D. (Lond.), Professor David Hare Training College, 14/6, Gariahat College, Calcutta 19.
- Ghoshal, (Dr.) R., M.Sc., M.B., D.T.M. (Cal. & Liv.) M. & H. (Lond.), 121/B, Grey Street, Calcutta 5.
- Ghoshal, (Dr.) S. L., Calcutta.
- Ghoshal, S. N., Reader in Physics, Dept. of Physics, University of Lucknow, Lucknow.
- Gillett, Metal & Steel Factory, Ichapur.
- Goenka, S. B., 160A, Chittaranjan Avenue, Calcutta.
- Goenka, (Mrs) S. B., 160A, Chittaranjan Avenue, Calcutta.
- Godbole, N.N., Director, Industries & Commerce, Rajasthan.
- Gode, K. D., M.Pharm., Lecturer, Dept. of Pharmaceutics, Banaras Hindu University, Banaras.
- Gohain, B. C., M.A., Anthropologist, Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta 13.
- Goil, M. N., M.Sc., F.Z.S. (Lond.), F.R.M.S. (Lond.), Dept of Zoology Bareilly College, Bareilly.
- Gopalan (Dr.), C., M.D. (Madras), Ph.D. (Lond.), Nutrition Research Laboratory, Coonoor.
- Gopalkrishna, N. R., 271, Chittaranjan Avenue, Calcutta.

- Gosling, G. W., F.R.M.S., Martine & Harris Ltd., Savoy Chambers, Wallace Chambers, Wallace Street, Fort, Bombay.
- Govindappa, A.A., 28A, Sridhar Sarkar Road, Calcutta.
- Gregory, P. J., Sp. Officer, Research, West Bengal, Directorate of Agriculture.
- Gruschwitz, K. H., M.Sc., Ph.D., Manager, Medical Dept., C/o. Ciba Pharma Ltd., 59/B, Chowringhee, Calcutta.
- Guha, Bhagawati Charan, D.Sc., Professor of Physics, Presidency College, Calcutta.
- Guha, M. L., B.Sc., Adair, Dutt & Co. (India) Ltd., Phiroz Shah Mehta Road, Bombay.
- Guha, M. R., B.M.E., A.M.I.E., Chief Engineer, Steel Products Ltd., 23H, Fern Road, Calcutta 19.
- Guha, (Mrs.) Mira, National Chemical Laboratory, Poona.
- Guha, S. K., M.Sc., Asst. Research Officer, Central Water and Power Research Station, Poona.
- Guha, S. R., National Chemical Laboratory, Poona.
- Guha (Mrs.) Sabita, (Indian Kunj), 163-F, Vincent Road, Bombay.
- Gura, S. S., Research Asst., Dept. of Organic Chemistry, Indian Institute of Science,
- Gupta, Jibandhan, Chemistry Dept., Medical College,
- Gupta, K. S., 3, Ecdalia Place, Calcutta.
- Gupta, H.C., Muslim University, Aligarh.
- Gupta, A. K., Sepulchre Brothers (India) Ltd., Bombay.
- Gupta, R. G., Vanaspati Factory, Dalmiananar.
- Gupta, Monoranjan, 9/E, Jogodyan Lane, Calcutta 9.
Bangalore 3.
- Gupta, (Miss) S. B., Retd. Principal, Lady Brabourne College, 244C, Vivekananda Road, Calcutta.
- Gupta, (Dr.) A., C/o. Burmah Oil Co., Ltd., Dibo, Assam.
- Gupta, R. S., M.Sc., Lecturer in Mathematics, University of Allahabad, Allahabad.
- Gupta, Suresh, Dept of Geology, Presidency College, Calcutta.
- Gupta, Trilok Chand, M.D. (Lucknow), Ph.D. (U.S.A.), Professor of Physiology, Darbhanga Medical College, Laheriasarai.
- Gulati, K. C., Indian Agriculture Research Institute, New Delhi 12.
- Gulati, M. R., M.Sc., Lecturer, Hans Ranj College, Chitra Gupta Road, New Delhi.
- Gyani, (Dr.) B. P. Asst. Professor of Chemistry, Science College, Patna.

H

- Hai, Mohammed Abdul, M.Sc., Scientific Officer, Central Laboratories for Scientific & Industrial Research, Narayanguda Section, Hyderabad-Deccan.
- Hawkins, (Mrs.) Helen C., Indian Veterinary Research Institute, Mukteswar-Kumayun, U. P.
- Hawkins, Philip A., Indian Veterinary Research Institute, Mukteswar-Kumaun.
- Hazari, (Prof.) Anandi, M.A., Head of the Dept. of Psychology, Langat Singh College, Muzaffarpur, Bihar.
- Hakson, H.N., 2B, Lord Singha Road, Calcutta.
- Heinz, Gobardhan Das, Desai & Co., Bombay.
- Hora, (Mrs) Vidya, C/o. Dr. S. L. Hora, D.Sc., F.N.I., Director, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta 12.
- Hossain, J., Grand Hotel,
- Hoon, R.C., Hirakound Research Station,
- Hoon, (Mrs) V., 171, Karnani State,

Hung, Htin, Ractor, Rangoon University, Rangoon.
HudJart, R., 6, Esplanade East, Calcutta.

I

Idnani, M.A., Chemistry Division, Indian Agriculture Research Institute, New Delhi.
Indra, (Dr.) Mohit Kumar M.Sc., D.Phil, Chemist, Burmah Oil Co. Ltd., Development Research Laboratory, Digboi.
Indira, (Miss) N., Mr. T. S. Padmanabhan, Gopu Nivas, Nageswarapuram, Mylapur, Madras.
Iyer, (Dr.) B. H., Lecturer in Organic Chemistry, Indian Institute of Science, Bangalore 3.
Iyenger, A. S. R., Zoological Survey of India, Calcutta.
Iyengar, (Miss.) Vanaja, F-9-410, Red Hills, Hyderabad-Deccan.
Iyengar, (Dr.) M. S., Central Laboratories for Scientific & Industries Research, Hyderabad-Deccan.

J

Jaiswal, G. P., Dept. of Zoology, Osmania University, Hyderabad-Dn.
Jaya ram, K. C., Zoological Survey of India, Calcutta.
Jacob, (Mrs) K., C/o. Dr. K. Jacob, Calcutta.
Jana, S.K., C/o. Indian Aluminium Co.
Jain, G. R., Victoria College, Goalior.
Jeroma, M., Gobardhandas & Co., Bombay.
Jhaba, U. S., 12, Lady Hardinge Road, New Delhi.
Jhuljhuwala,, Ram Kumar, 12, Gobinda Chandra Dhar Lane, Calcutta.
Jhingran, Vishwa Gopal, M.Sc., Ph.D., Research Officer, Central Fisheries Barrack-pore via Calcutta.
Joshi, (Mrs.) Indumati P., C/o. Shri P. N. Joshi, B.A., M.S., Principal & Secretary, Victoria Jubilee Technical Institute, Matunga, Bombay 19.
Joshi, M. L., The Ganga Glass Works Ltd., Balawali E. I. R., Bijnor-Dt.
Joshi, R. V., M.Sc., Lecturer in Geography-Geology, Karnatak College, Dharwar.

K

Kale, N. P., M.Sc., C/o. Lakes Pynuts & Chemist Ltd., 113, Vithaldas Chambers, Apollo Pier Road, Bombay 1.
Kalei, Tapas, M.Sc., Lecturer in Botany, Revenshaw College, Cuttack.
Kaleagi, T. N., Chemistry Dept., Lucknow University, Lucknow.
Kalra (Lt. Col.) S. L., Armed Force Medical College, Poona.
Kalra, S. N. Ph.D. (Illinois), Reader in Electronics, Physical Research Laboratory Navarangpura, Ahmedabad.
Kamath, (Miss) H. Sunande, Asst. in Botany, AC & RI, Lawbey Road, P. O., Coimbatore.
Kapat, G., M.Sc., Lecturer in Education, Calcutta University, Calcutta
Kapat, Dev Raj, Sambhunath Chemical Works Ltd., H32, Connaught Circus, New Delhi.

- Kapila, M. D., Asst. Chief Metallurgist, Tata Iron & Steel Co. Ltd., Jamshedpur.
- Kar, K. C., D.Sc., Senior Professor of Physics, Presidency College, Calcutta.
- Kar, Prithwish, M.Sc., Lecturer in Geology, Dept. of Metallurgy, Chemistry & Geology, B. E. College, Sibpur, Howrah.
- Karan, Pradyumna P. B.A., M.A., Asst. Professor of Geography, Patna University, Patna.
- Karbelkar, N. V., M.Sc., Lecturer College of Science, Nagpur.
- Kasbekar, (Dr.) G. S., Superintendent, High Explosive Factory, Kirkee, Poona.
- Kaushish, D. C., M.A., C/o. Durga Lakshmi Mills, Paharganj, New Delhi.
- Kar, K.C., 6-1-1, Ramanath Mazumdar Street, Calcutta.
- Kapur, S.L., National Chemical Laboratory,
- Kar, R. R. Chandor, C/o. Vijoy Glass Works, Margagaon Tram Terminus Bombay 10.
- Katra, (Miss) M., 171, Kanani State,
- Katra, R.N., 171, Karnani State,
- Kapur, S.N., 116, Karnani Mansion, Park Street, Calcutta.
- Kane, R. P., Physical Research Laboratory, Ahmedabad.
- Kamra, (Miss) N., Patna Psychological Institute, Patna.
- Kania, B. P., 15, Burdwan Road, Calcutta.
- Katbamukh, Basudeb, 3C, Nalini Sarkar Street, Calcutta.
- Kelkar, Bombay Haffin Institute, Bombay.
- Keskar, B. W., Chemistry Dept., Ferguson College, Poona 4.
- Keswani, Ram K., Chemistry Dept., Basantsingh Institute of Science, Pedder Road, Bombay 26.
- Khosla, M. C., Punjab University, Chemistry Dept., Hosierpur.
- Khajuria, H., Zoological Survey of India, Indian Museum, Calcutta 13.
- Khanna, B. K., C/o. Upper India Glass Works Ltd., Ambala City.
- Khanna, (R. B. Shri) D. K., C/o. Upper India Glass Works Ltd., Ambala City.
- Khanna, J. L., Lecturer in Psychology, Punjab University, 46, Darya Ganj, Delhi 7.
- Khanna, (Mrs.) Prabha, Research Scholar UNESCO Tension Project, 46, Darya Ganj, Delhi 7.
- Khemka, Kamalapati, 63, College Street, Calcutta.
- Khare, H. C., M.Sc., Lecturer in Mathematics, University of Allahabad, Allahabad.
- Khan, (Dr.) Mohd. Qadimaddin, Govt. Entomologist, Main Farm, Himayatsagar, Hyderabad-Deccan.
- Khan, A. Basir, Dept. of Zoology, Muslim University, Aligarh.
- Khan, Abrar M., Botany Dept., Muslim University, Aligarh.
- Khaitan, Basantalal, 12, Gobinda Chandra Dhar Lane, Calcutta.
- Kibble, W. F., M.A., Ph.D., Professor of Mathematics, Madras Christian College, Tambaram, Madras.
- Kirsh, (Rev.) Simon C., S.J., A.B., M.A., Ph.L., Dept. of Physics, Loyola School, Jamshedpur.
- Kothurkar, (Prof) V., Reader & Head of the Dept. of Expt. Psychology University of Poona, Ganeshkhind, Poona 7.
- Kotwal, Y. N., B.A., B.Sc., A.I.I.Sc., M.I.S.P., Chemist, Dadar Purification Works, Dadar, Bombay 28.
- Konar, Mohima R., Haringhata Firm, Govt. of West Bengal,
- Krishnaswami, Dept. Chem. Tech., Osmania University.
- Krishnan, V. Sivaram, 4, Nandi Street, Ballygunge, Calcutta.
- Kraus, R. A., Dr. Ing., Professor and Head of the Dept. of Mechanical Engineering, Indian Institute of Technology, Kharagpur.
- Kulkarni, (Dr.) C. V., Asst. Director of Fisheries, Taraporewala Aquarium, Netaji Subhas Road, Bombay 2.

- Kulkarni, B. S., Dept., Chem. Tech., Osmania University, Hyderabad-Dn.
 Kunda, S. K.,
 Kunte, Chintamani, Vishnu, 'Kunti Wada,' 464, M. Gahdhi Road, Sangli.
 Kuriyan, Chandy, Research Fellow, School of Entomology, St. John's College, Agra.
 Kuriyan, George, Ph.D., Professor of Geography, University of Madras, Madras.
 Kushwaha, R. S., Lecturer Mathematics Dept., Allahabad University, Allahabad.

L

- Lahiri, A.N., Damodar Valliey Corporation, Calcutta-27.
 Lahiri, Amiya K., 164, Manicktola Main Road, Calcutta.
 Lahiri, H. M., 2, Nanda Lal Bose Lane, Calcutta 3.
 Lakshmanan, M. A. V., Zoological Survey of India, 3, Chittaranjan Avenue, Calcutta.
 Lahiri, K. C., Fuel Research Institute, Jealgorah P. O., Manbhum.
 Lalithamba, (Sm.) B. V., B.Sc., Lecturer Vanivilas Institute, 22, Venkatapp's Lane, Chikkamavally, Bangalore 2.
 Lalkaka, (Capt.) K.A.J., 'Avasia House,' 2nd Floor, Darabsha Road, off Nepean Sea Road, Bombay 26.
 Lewis, (Mrs.) Sally, M.A., F.L.S., F.R.H.S., Professor of Botany, & Vice-Principal, Bethune College, 67, Park Street, Calcutta 16.
 Lodh, Satyendra Chandra, 1/2, Goalapara Road, Calcutta 34.

M

- Mathur, Krishna Gopal, Kusum Product Co., Rishra, Hooghly.
 Malhatrao, K. L., C/o. Sri B. L. Bahl, 2, Col. Biswas Road, Calcutta.
 Malhotra, J. C., Central Inland Fisheries, Barrackpore.
 Mathur, P.N., Govt. College, Ajmer.
 Mahmood, Hamid, Lecturer Zoology, Women's College, Aligarh.
 Maliya, V. B., 2, Minto Park, Alipore, Calcutta 23.
 Majumdar, R. M., 6, Esplanade East, Calcutta.
 Majumdar, Niloy, C/o. Dr. K. N. Bagchi.
 Majumdar, Sunil Chandra, B.Sc., Scientific Asst., Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
 Majumdar, Benoy Lal, M.Sc., A.M.Inst.F., Furnace Technologist, Bhowra Coke Company, Bhowra P. O., Manbhum.
 Majumdar, Nando Gopal Dept. of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Majumdar, Sailendra Nath, B.E., A.M.I.E., Superintending Engineer, Road Construction Circle No. I, W. & B. (West Bengal) 1, Dakhinpara Road, South Dum Dum, 24-Pargonas.
 Majumdar, Indian School of Mines, Dhanbad.
 Majumdar, J. K., 32A, Dharmatola Street, Calcutta.
 Manager, C/o M/s. Murarka Paint & Varnish Works Ltd
 Maitra, N. C., 12, Mission Row, Calcutta.
 Mallik, J., 25, Maharshi Debendra Road, Calcutta 7
 Manna, B., 25, Maharshi Debendra Road, Calcutta 7.
 Macmillan, (Dr.) W. G., Indian Jute Mills Research Institute, Calcutta 27.

- Maity, Pranabes Chandra, C/o. Late Prof. B. M. Barua, 49-1, Baldeopara Road, Manicktola, Calcutta 6.
- Mandal, A. K., 5/17, Western Extension Area, Karolbagh, New Delhi 6.
- Mandal, (Sm.) A. K., 5/17, Western Extension Area, Karolbagh, New Delhi 6.
- Mathur, P. M., Manager & Chief Chemist, Snow White Food Products Co. Ltd., 167, G. T. Road, Shibpore, Howrah.
- Mathur, R. S., M.Sc., B.Sc. (Hons.), A.M.Inst.P. (Lond.), Professor of Physics, D. A. V. College, 7-63, Tilak Nagar, Kanpur.
- Mathew, K. T., Research Student, University Botany Laboratory, Madras 5.
- Marathe, M. G., University of Poona, Dept. of Chemistry, Poona 4.
- Maru, (Miss) Jaya, M.A., L.T., Professor & Head of the Dept. of Botany, Holy Cror College, Teppakulam P.O., Trichinopoly.
- Mazumdar, Himangshu Bimal, M.Sc., B.T., M.R.S.T. (Lond.), Principal, Basic Training College, Banipur, 24-Pargonas.
- Mazumdar, Monomohan, M.Sc., Asst. General Manager, Ramnugger Cane & Sugar Co. Ltd., Plassey P. O. Nadia.
- Mahendaley, V. G., B.Sc., L.T.C., D.I.C. (Lond.), Chemist, High Explosives Factory, Kirkee, Poona 3.
- Mehta, B. S., Garrison Engineer, M.E.S., Allahabad.
- Mehta, D. R. S., Geologist, Geological Survey of India, 27, Chowringhee Calcutta 13.
- Mehta, (Dr.) P. C., The Ahmedabad Textile Industries Research Association Navarangapura, Ahmedabad.
- Meni, (Dr.) P. S., Director-in-Charge, Laxminarayan Institute of Tecnology, Nagpur University, Nagpur.
- Merchant, S. H., B.Sc., B.Pharm. (Lond.), Ph.C., M.P.S., Asst. Drug Controller, Govt. of India, Directorate General of Health Services, Custom House, 10, Hunger Ford Street, Calcutta 16.
- Menan, A. G. K., Asst. Zoologur, Zoological Survey of India, Calcutta.
- Mehta, P.R.,
- Mirchandani, T. J., M.Sc., Ph.D., Head of the Division of Agronomy, Indian Agriculture Research Institute, New Delhi.
- Misra, A. P., M.Sc., Ph.D., Asst. Systematic Mycologist, Directorate of Plant Protection, Quarantine & Storage, Division of Mycology, Pusa Buildings, New Delhi 12.
- Misra, Savitri, C/o. Dr. R. S. Misra,
- Mitra, Samarendranath, 1, Matilal Bysack Garden Lane, Calcutta.
- Mitra, Shanti, 22B, Nalini Sarkar Street, Calcutta.
- Mitra, (Mrs) Nilima, 7, Kristo Mullick Lane, Belgachia, Calcutta 37.
- Mitra, S. B., 7/1A, Grey Street, Calcutta 5.
- Mitra, Asoke K., 8, Paul Mansions, 6, Bishop Library, Calcutta 20.
- Mitra, Sudhir Ch. 41-7, Charu Chandra Avenue, Tellygunge, Calcutta.
- Mitra, Rabin, 20, Cossipore Road, Calcutta.
- Mitra, Bholanath, Dhanbad School of Mining, Dhanbed.
- Bhavanani,
- Mitra, K.K., Lecturer, Food, Technology, College of Engineering, Jadavpur.
- Mitra, S. K., 204, Barrackpore Trunk Road, Calcutta 35.
- Mitra, Anil, M.Sc., 3-1, Bamanpara Lane, Ballygunge, Calcutta 19.
- Mitra, Debendra Nath, M.A., Professor of Mathematics, Presidency College, Calcutta.
- Mitra, H. N., Senior Scientific Officer, Officer-in-Charge, Medical Stores Inspection Dept., Havelock Lines, Lucknow.
- Mitra, (Capt.) R. D., M.Sc, M.L.T., Entomologist, Armed Force Medical College, Poona 1.
- Mitra, S. N., Research Officer, All India Radio, Curzon Road, Barracks, New Delhi,

- Mitra, Shib Kumar; M.A., Lecturer in Psychology, Psychological Institute, Patna 5
 Mitra, Sisir Kumar, Electrical Engineer, 87, Shyambazar Street, Calcutta.
 Mitra, Sudhansu Baran, 18A, Brindaban Bose Lane, Calcutta 6.
 Mitra, Suborna, 25-1, Chandra N. Chatterjee Street, Calcutta.
 Mitra, S. D., Jute Agricultural Research Institute, Hoogly.
 Mitra, C. R., M.Sc., Junior Scientific Officer, National Chemical Laboratory of India, Poona 7.
 Misra Gadadhar, M.Sc., Lecturer Dept. of Botany, Ravenshaw College, Cuttack 3.
 Misra (Dr.) K. S., Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta 12.
 Misra, V. S., M.Sc., Ph.D., Lecturer in Chemistry, Lucknow University, Lucknow.
 Mistry, Sherier, S.,
 Mistry, (Mrs.) Coomi S.,
 Mookerji, S., 7, Chittaranjan Avenue, Calcutta.
 Motweane, M.P., Central Fisheries, Barrackpore.
 Moonje, R.D., Protap College, Amalner (E.K.).
 Mookerjee, P. N., 272, Rashbehari Avenue, Calcutta.
 Mookerjee, 57/2, Padmapukur Road, Calcutta.
 Mookerjee, A. K., M.Sc., 26, Ramesh Mitra Road, Calcutta 25.
 Mookerjee, Bireswar, M.Sc., "Bakulia House," Kidderpore, Calcutta 23.
 Mookerjee, Krodhjit, B.S. Asst. Shift Charge Engineer, Mulajore Generating Station, Calcutta Electric Supply Corporation, 19, Behari Doctor Road, Calcutta 25.
 Mookerjee, (Dr.) Profulla, Supdt., Biological & Biochemical Dept., The Lister Antiseptics & Dressings Co. (1928) Ltd., 12, Umakanta Sen Lane, Calcutta 2.
 Mookerji, Shankarananda, Chemist Qumareish House, 61, Hurroganj Road Salkia, Howrah.
 Moorthy, B. A. Sundara, B.E., A.M.I.E., Lecturer Dept. of Chemical Engineering, Indian Institute of Science, Bangalore 3.
 Moghni, Shahabuddin Md., Lecturer in Psychology, Muslim University, Aligarh.
 Mohanty, Udayanath, M.Sc., D.I.C., Asst. Director of Agricultural Research, Dept. of Agriculture, Cuttack.
 Mohanty, (Mrs.) Shantilata, Lecturer in Zoology, Ravenshaw College, Cuttack 3.
 Mohanti, P. C., D.Sc., F.N.I., Head of the Dept. of Applied Physics, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Mohury, B. D., 5, Lower Rawdon Street, Calcutta.
 Mukherjee, A. K., Presidency College, Calcutta.
 Mukherjee, G.C., Defence Science Laboratory, New Delhi.
 Mukherjee, Jadulal, Professor of Chemistry, Cotton College, Gauhati.
 Mukherjee, J. B., Control Officer, Technical Development Establishment, Box 320, Kanpur.
 Mukherjee, B. C., 15, Wood Street, Calcutta.
 Mukherjee, Debabrata, 79/16A, Lower Circular Road, Calcutta 14.
 Mukherjee, Jagadananda, 302, Upper Circular Road, Calcutta-9.
 Mukherjee, Sudhir Kumar, Roynagar, P.O. Boral, 24-Parganas.
 Mukherjee, Sarat Kumar.
 Mukherjee, Kishory Prosad, 252B, Upper Chitpur Road, Calcutta 3.
 Mukherjee, B. N., 60, Pratapaditya Road, Calcutta.
 Mukherjee, Mohi Mohan, 14, Congress Exhibition Road.
 Mukherjee, Basanta K.,
 Mukherji, P. C., Presidency College,
 Mukherjee, D.N., Tittagarh Paper Mills No. 1, Soda Recovery Plant.
 Mukherjee, Jyoti Bhusan, M.Sc., M.B., 32, Boloram De Street, Calcutta 6.
 Mukherjee, S.L., 18-5, Dihl Seerampore Lane, Ballygunge, Calcutta.
 Mukherjee, S. M., Punjab University, Chemist Dept., Hosierpur.

- Mukherjee, B. B., D.Phil., Fuel Research Institute, Jealgorah P.O., Manbhum.
 Mukherjee, Bibhuti Charan, 2, Nayaratna Lane, Calcutta 4.
 Mukherjee, (Dr. Mrs.) Binapani, Professor of Geography, Lady Brabourne College, P1/2, Suhrawardy Avenue, Calcutta.
 Mukherjee, Bankim Chandra M.Sc., F.G.S., A.M.Inst.F., F.M.G.S., Geologist, 26/C, Rash Bagan Lane, Calcutta 10.
 Mukherjee, H. S., M.A., 18, Hegsham Road, Calcutta 20.
 Mukherjee, R., Ph.D., Biochemist, Indian Veterinary Research Institute, Mukteswar Kumaun P. O., Nainital.
 Mukherjee, Ram Krishna, B.E., 2, Raja Peary Mohan Road, Uttarpara, Hooghly.
 Mukerjee, Susil Kumar, Curator of Herbarium, Indian Botanic Garden, Botanic Garden P. O., Howrah.
 Mukhopadhyay, Kanailal, School of Tropical Medicine, Calcutta.
 Murti, G.S., Indian Agricultural Research Institute, New Delhi.
 Muley, L. N., M.Sc., Ph.D., Dept. of Chemistry, Institute of Science, Bombay 1.
 Mulick, S. N., M.E., Director, Jnananda Industries Ltd., Sunkerpore House, Ukhra P. O., Burdwan.
 Murthy, S. N. B., B.Sc., B.E., Indian Institute of Technology, 5, Esplanade East, Calcutta.
 Muthusamy, M. S., Head of the Zoology Dept., P. R. College, Kakinada. (S. India).
 Mutto, (Pandit) R. N., D.Sc., LL.B., Archadist & Agriculture, Hony. Deputy Director of Agriculture, Uttar Pradesh Govt., Ramgauh P. O., Nainital—Dist.

N

- Nadkarni, G. B., C/o. Sri B. D. Nadkarni, District & Session Judge, Sangali, Bombay State.
 Narang, Punjab University, Chemist Dept, Hosierpur.
 Nair, K. P. N., Indira Mahal, Calcutta.
 Nasiruddin, K., Grand Hotel,
 Nandy, Profulla Ch., 209, Cornwallis Street, Calcutta.
 Nag Chowdhury, Ajit K., 16, Gour Mohan Mookherjee Street, Calcutta.
 Nag, Arya Kumar, 109, Karnatak Surveys, Hubli P. O., Dharwar Dist., Bombay.
 Nagabhusanam, (Dr.) K., Andhra University, Dabagarden, Waltair.
 Nath, H.P., Defence Science Laboratory, New Delhi.
 Nannia, R. P., 15, Burdwan Road, Calcutta.
 Narasimharao, Ch., 27, Chowringhee, Calcutta 13.
 Nanda, (Miss) J., 171, Karnali State,
 Narayana, Jaipur.
 Naidu, M. G. Chakrapani, Dept. of Geology, Central College, Bangalore.
 Naik, K. G., M.A., D.Sc. (Lond.), F.N.I., Rector, Gujrat University, Ahmedabad 9.
 Naidoo, (Srimati) Raja Bai, C/o. T. V. R. Naidoo, Esqr., University Engineer, Waltair.
 Narayan, P. K., M.Sc., Lecturer, Patna Womens College, Patna.
 Nayar, A. P. Madhavan, Dept. of Georaphy, University of Madras, Madras.
 Nair, (Dr.) K. K., Biology Dept., Wilson College, Bombay 7.
 Neogy, Sukumar, 94-7, New Shambazar Street, Calcutta.
 Nerurkar, B. Y., P.O. Angus, Hooghly.
 Nigam, (Dr.) S. D., Dept. of Applied Mathematics, Indian Institute of Technology, Hijli, Kharagpur, (B. N. Rly.).
 Nijhawan, K. K., Head Laboratory Supervisor, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.

Nimkar, (Miss) S., B.Sc. (Hons), Ph.D. (Lond.), D.I.C. (Lond.), Research Officer, Division of Chemistry, Indian Agriculture Research Institute, Pusa, New Delhi.

Niyogi, 6-7, Lower Circular Road, Calcutta.

Nyunt, U. Hlas, Dept. of Physics, Rangoon University, Rangoon.

O

Ogale, D. P., C/o. The Nagpur Glass Works Ltd., Nagpur 2.

P

Padamanabhan, T. S., Junior Electrical Engineer, Gopi Nivas, Naggwarpura, Mylapore, Madras.

Pande, S. K., D.Sc., Reader in Botany, Lucknow University, Lucknow.

Pandih, S. V., B.Sc., B.Sc., (Agric.), Plant Pathological Asst., Main Farm, Himayat-sagar P. O., Hyderabad-Deccan.

Pasricha, Geeta, 272, Rashbehari Avenue, Calcutta.

Parikh, K. H., Alembic Glass Industries, Baroda 3.

Patel, D. K., S. R. S. Pdegaon, P.O. Nira, Dt. Poona.

Pain, Santosh K., Agricultural Economic, Haringhata Firm, Govt. of West Bengal,

Paul, S.S., Jute Research Institute, Regent Park.

Padmanabhan, C.V., Institute of Jute Technology, Bally.

Panji, R. R., Sugar Cane Breeding Institute, Coimbatore.

Pandey, (Kumari) Nirmala, M.A., C/o. Dr. P. L. Srivastava, 5, Lajpat Rai Road, New Katra, Allahabad.

Pandit, (Dr.) C. G., Secretary, Indian Council of Medical Research, Post Box No. 494, New Delhi.

Panigrahi, Gopi Nath, M.Sc., Lecturer in Botany, Ravenshaw College, Cuttack.

Panigrahi, Nihar Ranjan, B.Sc., Assoc. I.A.R.I., Second Economic Botanist, Department of Agriculture, Cuttack 1.

Pal, Birendra Chandra, 104, Mechuabazar, Calcutta-7.

Pal, Aswani Kumar B.M.E., Asst. Professor Mechanical Engg., College of Engineering & Technology Bengal, Calcutta 32.

Pal, Dilip Kumar, M.A., Silpukuri, Gauhati.

Pant, C. M., C/o. Mr. K. P., Shanta, Asst. Research Officer, Soil Laboratory, U. P. Irrigation Research, Bahadradab, Saharanpur-Dist.

Pant, N. C., M.Sc., Ph.D. (Lond.), Technical Officer, Directorate of Plant Protection, Quarantine & Storage, Division of Entomology, Pusa Building, New Delhi.

Panth, Bhola D., B.E., E.E., Ed.D., Deputy General Manager, P. & T. Workshop, Calcutta 27.

Pantulu, V. R., B.Sc., M.Sc., Research Asst., Central Inland Fisheries Research Station, Barrackpore via Calcutta.

Paranjpe, (Mrs.) Nilini J., C/o. Prof. G. R. Paranjpe, 202-1, Sadashiv, Poona

Paranjpe, (Mrs.) Malini, C/o. Prof. G. R. Paranjpe, 202-1, Sadashiv, Poona.

Parija, Banshidhar, M.Sc., Ph.D., Economic Botanist-Cum-Paddy Specialist, Orissa Dept. of Agriculture, Cuttack 1.

Patel, C. B., B.E., A.M.I.E., Superintending Engineer, in Special Duty, Central P.W.D., 'L' Block, New Delhi.

- Patnayak, K. C., M.Sc., Demonstrator of Chemistry, Dept. of Physiology, Medical College, Cuttack.
- Pathak, K. C., Office of the Govt. Inspector of Railways (Circle No. 2), 6, Deccan Lane, Esplanade East, Calcutta.
- Pathak, (Prof.) P. D., L. D. Arts College & M. G. Science Institute, Ahmedabad.
- Patwardhan, (Mrs.) Kamal, 409, Sadashiv, Poona 2.
- Patwardhan, W. D., M.Sc., Ph.D., Asst. Inspector of Military Explosives Inspectorate of Military Explosives, Kirkee, Poona.
- Pattnaik, Harihar, M.Sc., Lecturer in Botany, Ravenshaw College, Cuttack 3.
- Pawar, M. S., Rice Specialist, Dept. of Agriculture, Govt. Main Agriculture Farm, Himayatsagar, Hyderabad-Deccan.
- Phansalkar, V. K., University of Poona, Dept. of Chemistry, Poona 4.
- Philipose, (Dr.) M. T., Central Inland Fisheries, Dry Dock, Jobra, Cuttack.
- Pillai, A. Ramanatha, C/o. Registrar, University of Madras, Madras.
- Principal, Allahabad Agricultural Institute, Allahabad.
- Poddar, Kesori Prasad, 37, Vivekananda Road, Calcutta 7.
- Poddar, B.P., Jakaria Street, Calcutta.
- Poddar, D.L., Medical College, Calcutta.
- Pradhan, V. S., Asst. Director, Bureau of Mines Govt. of India, New Delhi.
- Prakash, Ravi, M. B., Technological Institute, Kanpur, Uttar Pradesh.
- Pradhan, K.S., Curator, Zoological Garden, Calcutta.
- Pramanik, B. N., M.Sc., Ph.D. (Lond.), Govt. Sugarcane Research Station, Shalijahanpur.
- Prasad, N., The Institute of Agriculture, Anand (B.B.C.I.Rly.).
- Prasada, (Dr.) R., Asst. Plant Pathologist, C/o. Mycology Division, Pusa Institute, New Delhi 12.
- Prasad, R. N. Lecturer in Zoology, Central College, Bangalore.
- Prasad, S. M., M.Sc., Ph.D. (Leeds), Provincial Industrial Research Laboratory, Patna 5.
- Prasad, (Dr.), S. N., Senior Scientific Officer, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
- Pruthi, (Mrs.) H. K., 12, Akbar Road, New Delhi.
- Pruthi, (Dr.) H. S., 12, Akbar Road, New Delhi.
- Pratap, Rabindra, M.A., Inspector, Social Service, Asifabad, Asifabad-Dist., Hyderabad-Deccan.
- Principal, Bhawan Govind Rani Seksaria, Teacher's Training College, Udaipur.
- Purkayastha, S. K., M.Sc., Wood Anatomy Branch, Forest Research Institute, New Forest P.O., Dehra Dun.
- Purkayastha, P. B., Coal Com. Office, 1, Council House Street, Calcutta.
- Puri, R. P., M.Sc., Ph.D., A.R.T.C., A.R.I.C., A.M.Inst.F., Scientific Officer, Fuel Research Institute, Digwadih, Jealgorah P.O., Manbhum.
- Puri, Shyam Nath, Asst. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Puri, (Dr.) V., Meerut.

Q

- Quadros, Albert S.de, Agricultural Research Laboratory, Laskar, Gwalior. (M.B.).

R

- Rao, V. S
- Rao, K. N. P.,

Rao, C. Nageswar, 27, Chowringhee Road, Calcutta.

Rao, N.V. Subha, Nizam,

Rao, T. Ananda, M.Sc., Lecturer in Botany, Gujrat College, Ahmedabad.

Rao, V. N., Ramanatha, B.A., B.L., 2, Village Road, Madras 6.

Rao, Y. Sundar, Lecturer in Botany, University of Saugor, Sagar.

Rao, A. Joga, D.Sc., Planing Officer, C.E.C.R.I., Sekhalai, Karaikudi.

Rao, A. Joga, A12-35, Gaganmalial Road, Domalguda, Hyderabad-Dn.

Rao, B. Venkata, M.Sc., Lecturer in Botany, Andhra University, Waltair.

Rao, C. B., M.Sc., L.T., Ph.D. (Lond.), Professor of Botany, Presidency College, Madras.

Rao, (Dr.) C. Krishna, Lecturer in Animal Husbandry, Madras Veterinary College, Madras 7.

Rao, D. Sethu, Demonstrator in Chemistry, 138, Bishop Helen Hall, Madras Christian College, Tambaram, Madras.

Rao, (Dr.) K. S., Dept. of Statistics, University of Bombay, Bombay.

Rao, K. S., M.Sc., Controller of Patents & Designs, 214, Lower Circular Road, Calcutta 17.

Rao, M. B. Ramchandra, M.Sc., M.A., I.M.E., Geophysicist, Geological Survey of India, 27, Chowringhee, Calcutta 13.

Rao, (Dr.) M. N., 110, Chittaranjan Avenue & Hygiene Institute Dept. Industries, Hygiene, Calcutta.

Rao, L. Bhaskara, M.Sc., F.R.S.A., Chief Chemist & Technologist, The Britannia Biscuit Co., Ltd., Mazagon, Bombay 10.

Rao, (Capt.) S. B. V., Research Officer, Poultry Research Section, Indian Veterinary Research Institute, Izatnagar.

Ray Choudhuri, Murari Mohan, Professor of Mathematics, Presidency College, Calcutta.

Ray Choudhury, Sunil Kumar, Lecturer in Geology, Calcutta University, 6, Mysore Road, Calcutta 26.

Ray, Subimal Chandra, Dy. Public Analyst to Govt. U.P.

Ray, Sailesh Ch., Rampurhat, Birbhum.

Ray, G. K., M.Sc., D.Phil., etc.

Ray Chaudhuri, P. C., Professor, Victoria College, Comilla.

Ray, S. C., Debibarih Colony, Calcutta 28.

Ray, Sudhindranath, 95G, Beltala Road, Calcutta 26.

Ray Chaudhuri, Swaha, 84, Haris Mookerjee Road, Calcutta.

Ray, M. K., P.O. Achhipar, 24-Parganas.

Ray, Basudev, Laboratory Law College Building, Poona 4.

Ray, Dipak Kumar, Indian Veterinary Research Institute, Mukteswar Kumaun.

Ray, J. K., Executive Engineer, Irrigation Division, Bankura.

Ray, K., B.E., C.E., M.I.E., General Manager, Annapurna Metal Works, 3, Asu Biswas Road, Calcutta 25.

Ray, Nirmalendunath, D.Sc., Professor of Chemistry, Presidency College, Calcutta.

Ray Chaudhuri, A. K., B.Sc., B.Ag., Dip.Agric. (Cantab.), Agronomist, Central Livestock Research-cum-Breeding Station, Haringhata, Barajaguli, Nadia.

Ray Choudhuri, Kartik, M.Sc., Lecturer in Experimental Applied Psychology, Muslim Raheja, (Dr.) P. C., M.Sc., Ph.D., Agronomist, Indian Agricultural Research Institute, Division of Agronomy, New Delhi.

Raja, (Dr.) K. C. K. E., Director General of Health Services, Central Secretariat, New Delhi.

Rajagopalan, M., M.Sc., A.R.I.C., F.Ind.Chem.E., Works Manager, Waldies Zinc Pigments Ltd., Konnagar P.O., Hooghly.

- Rajagopalan, (Dr.) R., Food Technology Laboratory, Indian Institute of Science, Bangalore 3.
- Rajagopalan, (Dr.) Y. V., Poona.
- Raju, M. Sanyasi, Govt. Agricultural Chemist, Indian Agricultural Research Institute, Lawby Road, Coimbatore.
- Ram, Atma, D.Sc., Joint Director, Central Glass & Ceramic Research Institute, Jadavpur College, Calcutta 32.
- Ramavataram, K., Dept. of Physics, Osmania University, Hyderabad-Dn.
- Ranadive, (Dr.) Kamal J., Tata Memorial Hospital, Parel, Bombay.
- Rangan, (Mrs.) S., C/o. Sri V. A. K. Rangan, 5, Goaplakrishna Road, Thyagarayanagar, Madras 17.
- Rakhil, P. C., M.Sc., Ph.D., Professor of Chemistry, 2E, Ghoshal Street (Top Floor), Calcutta 19.
- Rakshpal, (Dr.) R., Warden, Ismail Building Hostel, The University, Lucknow.
- Rastogi, M. C., Lecturer, Chemistry Dept., Lucknow University, Lucknow.
- Rastogi, R. P., Lecturer, Chemistry Dept., Lucknow University, Lucknow.
- Rath, M.A., Ph.D. (Lond.), Ravenshaw College, Cuttack 3.
- Rajarajan, K., Asst. Geologist, Geological Survey of India.
- Rakshit, J. N., P-563, Rashbehari Avenue, Calcutta.
- Ramakrishnan, G., Zoological Survey of India, Calcutta.
- Rabbini, M. G., Hindusthan Air Craft Factory, Bangalore.
- Rahmen, A., Safabad College, Hyderabad.
- Rafay, S. A., Sugar-Cane Pathologist, Pusa.
- Radhakrishnan, T., Central Imperial Hotel, Central Avenue.
- Rath, Profulla Ch., 223, Chittaranjan Avenue, Calcutta-6.
- Keddi, D. V., 45, West, The Park, Ichapur, 24 Parganas.
- Reenink, H., Harinagar Sugar Mills, Bihar.
- Rev. R. Lepour, St. Joseph's College, Darjeeling.
- Reddy, D. Bap, M.Sc., Ph.D. (California), Himayatsagar Farm, Dept. of Agriculture, Hyderabad-Deccan.
- Reddy, M. K., Senior Assistant, Soil Research, Govt. Farm, Rudrur P.O., Nizambad.
- Roy, (Prof.) S. K., M.Sc., Dept. of Chemistry, Gokhale Memorial College, Harish Mukherjee Road, Calcutta.
- Roy, (Dr.) S. K., Ph.D., Dabor Colliery, Samdih P.O., Burdwan.
- Roy, Satyendra Nath, M.Sc., Vice-Principal & Professor of Physics, Krishnagar College (Retd.), Krishnagar P.O., Nadia.
- Roy, Tependra Chandra, Dept. of Applied Mathematics, Science College, 92, Upper Circular Road, Calcutta 9.
- Roy, M., 5, Durga Pituri Lane, Calcutta 12.
- Roy Choudhury, Nalin Behari, M.B., Mg. Director, Indian National Drug Co., Ltd., 5-2, Beliaghata Main Road, Calcutta 10.
- Roy, Fankoj, Junior Scientific Officer, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
- Roy, S. B., Senior Scientific Officer, Central Glass & Ceramic Research Institute, Jadavpur College, Calcutta 32.
- Roy, S. K., M.Sc., 5A, Rajendralal Street, Calcutta 6.
- Roy, A. K., Director, Regional Meteorological Centre, Lodhi Road, New Delhi.
- Roy, P. K., M.B.
- Roy, D. C., 7A, Moti Jhil Avenue, Calcutta 28.
- Roy, Nireesh Chandra, Rampurhat College, Birbhum.
- Roy Choudhury, Rabindra Nath, 12-1, Jamir Lane, Calcutta 19.
- Roy, R.Y., Asst. Prof. of Biology, Benaras Hindu University, Banaras.

Roy, A. R., 35/38, Ferozesah Road, New Delhi.

Roy, S.B., 15A, Earle Street, Calcutta-26.

Roy, M.K., P. O. Achhipur.

Rohatgi, Shakuntala, 45, Armenian Street, Calcutta.

Rudra, Leena, 1, Shibnarain Das Lane, Calcutta 6.

Rudra, C. B., M.Sc., Principal, Indian Institute of Electronics, 8-B, Raja Naba-kessen Street, Calcutta 5.

S

Sadasivan, V., Asst. Fisheries Research Officer, Port Blair.

Saha, C. C., Sound Recordist & Radio Business, 45, Moti Sil Street, Calcutta.

Saha, K. C., D.Sc., Asst. Director of Fisheries, Govt. of West Bengal, Writers' Building, Calcutta 1.

Saha, (Prof.) N. M., Professor of Physics, Central Calcutta College, 8, Wellesly Street, Calcutta 13.

Sahay, J. N., M.Sc., Ph.D. (Beneras), Ph.D. (Lond.), Asst. Professor of Chemistry, Science College, Patna 5.

Samaddar, Prasanta Kumar, 6, Brindaban Mullick 1st Lane, Calcutta 9.

Samantarai, B., M.Sc., Ph.D. (Lond.), D.I.C., Professor of Botany, Revenshaw College, Cuttack 3.

Sanyal, (Mrs.) Sobha, C/o. Sri D. C. Sanyal, Indian Wood Products Co., Ltd., Bareilly, Izatnagar.

Santholia, Radha Kissen, 37, Vivekananda Road, Calcutta 7.

Saraswat, H. C., 112-243, Aryanagar, Kanpur.

Sarbadhikari, (Prof.) P. C., 84, Ballygunge Place, Calcutta 19.

Sarda, Gouri Sankar, Geologist, Chaibasa P.O., Manbhum.

Sardar, Ajit Kumar, 8-3, Chintamani Das Lane, Calcutta 9.

Sarin, (Dr.) J. L., Asst. Secretary, National Institute of Sciences of India, Mathura Road, New Delhi.

Sarma, A. K., 84A, Vibekananda Road, Calcutta.

Sarma, J., 92, Upper Circular Road, Calcutta.

Sarma, M. S., Jute Agricultural Research Institute, Hooghly.

Sarma, (Dr.) P. S., Bio-chemical Laboratory, University of Madras, Madras 5.

Sarkar, B., M.Sc., Statistician, The Calico Mills, Post Box No. 12, Ahmedabad.

Sarkar, (Prof.) Indubhusan, M.Sc., Professor Cotton College, Professors Para, Gauhati.

Sarkar, P. B., Regent Park, Tollygunge, Calcutta.

Sarkar, (Mrs) Ira, 55, Girish Mukherjee Road, Calcutta 25.

Sarkar, Jogendra Nath, B.A., B.Sc., Chemical Engineer, 26A, Pandit Road, Calcutta 29.

Sarkar, Satyabrata, M.Sc., Research Scholar, Plant Physiology Section, Bose Research Institute, 93-1, Upper Circular Road, Calcutta 9.

Sarkar, S. N., M.Sc., Ph.D. (Edin.), F.G.M.S., 95-A, Ballygunge Gardens, Calcutta 19.

Sarkar, Shyama Pada, B.Sc., Chemist, O. R. C. L. Limited, 61, Hurroganj Road, Salkia, Howrah.

Sarkar, Udaynarayan, M.Sc., Geological Asst., D.V.C., Geological Survey of India, 27, Chowringhee, Calcutta 13.

Satyasray, (Dr.) Ranjit Singh, The Cosmopolitan Polyclinic, 19, Mistrypara Road, Jadavpur, Calcutta 32.

Saxena, P. N., M.Sc., Research Scholar, Zoology Dept., Patna Science College, Patna.

- Savithramma, (Sm.) B. V., M.Sc., Maharani's College for Women, Lecturer in Physics, Bangalore.
- Sanyal, Saroj Bandhu, Presidency College, Calcutta.
- Sanyal, D., 1, Council House Street, Calcutta.
- Saxena, Ram Sahai, Herbert College, Kota, Rajutana.
- Sathe, R.B., 6, Esplanade East, Calcutta.
- Sastri, R. L. N., 26, Ballyganj Gardens, Calcutta.
- Sarojini, K. K., Asst. Research Officer, Central Inland Fisheries, Barrackpore, 24-Parganas.
- Sarin, P. C., C/o. Messrs. Kilburn & Co., Ltd., 4, Fairlie Place, Calcutta 1.
- Saha, J. C., C/o. Dr. J. C. Saha, 6-B Nandalal Bose Lane,
- Saha, K.L., Oriental Chemical Works, Chetla.
- Sahani, M.R., C/o. Geological Survey of India,
- Samiullah, M., Safabad College, Hyderabad.
- Sankar, B.K., Jute Agricultural Research Institute, Barrackpore.
- Sanyal, (Mrs) Protima, Asst. Prof. Physics, Mahalla College Patna.
- Sarabhai, M. V.,
- Sarbadhikary, B.R., Medical College, Calcutta.
- Sahu, H.L., Prof. Physiology, N. S. Medical College, Calcutta.
- Saxena, B.D., Dept. of Physiology, Allahabad University, Allahabad.
- Sen, J., Botany Dept., Calcutta University.
- Sen, (Mrs) M., 1, Ballyganj Park, Calcutta.
- Sen, S., Assam Bengal Cement Co. Ltd
- Sen, A. C., Blood Transfusion Office, Medical College, Calcutta.
- Sen, Dhruba Kr., M.B.B.S., 223, Chittaranjan Avenue, Calcutta 6.
- Sen, J. R., D.O.F., 6, Esplanade East, Calcutta.
- Sen Gupta, A., The Retreat, Jadavpur.
- Sen Gupta, N. N., 1, Harish Mukherjee Road, Calcutta.
- Sen, N. C., College of Engineering & Technology, Jadavpur.
- Sen, S., 46, Dharmatala Street, Calcutta.
- Sen, P. C.,
- Sen, Bina, M.A., 281C, Vivekananda Road, Calcutta 16.
- Sen, B. K., Presidency College,
- Sen Gupta, R. L., Presidency College,
- Sen, K. M., 16F, Dover Lane, Calcutta.
- Sen Gupta, J. N., 35, Gopal Nagar Road, Alipore, Calcutta 27.
- Sen-Gupta, K. K., 4-1-B, Beadon Street, Calcutta.
- Sen, Barid Baran, Science College, Calcutta.
- Sen, B. C., Cooper Lane, Mission Road, Extension, Calcutta 1.
- Sen, Amitava, Kharagpur College,
- Sen, Debabrata, C/o. N. K. Sen,
- Senigupta, N. R., 47, Garcha Road, Calcutta 19.
- Sen-Gupta, Raghunath, Forest Research Institute, Deradun.
- Schinzl, (Dr.) T., Sandoz Products Ltd., 3, Wittott Street, Ballard Estate, Bombay 1.
- Senapati, J. M., M.B.B.S., Research Fellow, I.C.M.R., Dept. of Physiology, Medical College, Cuttack.
- Sen, (Prof.) A. C., Sabour P.O., Bhagalpore Dist., Bihar.
- Sen, A. K., Director West Bengal Public Health Laboratory, School of Tropical Medicine, Calcutta 12.
- Sen, Amar Kumar, M.Sc., 223, Chittaranjan Avenue, Calcutta 6.
- Sen, (Miss) Bijoya, M.A., 951, Garpar Road, Calcutta 9.
- Sen, B. M., 12, Ballygunge Circular Road, Calcutta 19.

- Sen, K. C., D.Sc., Director, Indian Dairy Research Institute, Hosure Road, Bangalore.
- Sen, Matiswar, 8, Bosepara Lane, Calcutta.
- Sen, (Mrs.) Malina, C/o. Sri J. R. Sen, Asst. Engineer, Bengal Paper Mills Ltd., Raniganj.
- Sen, M. R., G.B.V.C., Asst. Superintendent, Bengal Veterinary Research Institute, Belgachia, Calcutta 37.
- Sen, N. K., Chemist, 7, Kalidas Lane, Calcutta 13.
- Sen, Nirod Kumar, M.Sc., D.Phil., Ph.D. (California), Professor of Botany, 1-6, Prince Golam Mohemmed Road, Calcutta 26.
- Sen, Phani Bhusan, M.Sc., Chief Chemist, Standard Chemical & Pharmaceutical Works, 1, Jaharlal Dutta Lane, Calcutta 4.
- Sen, R. N., M.B., Demonstrator, Physiology Department, Medical College, Cuttack.
- Sen, R. N., M.Sc., 35, Simla Street, Calcutta 6.
- Sen, (Sm.) Usha, M.A., Cartographer, Dept. of Geography, Senate House, Calcutta University, Calcutta 12.
- Sen Gupta, Gokul Chandra, B.Sc.Ag., Assoc.I.A.R.I., State Entomologist Orissa, Cuttack.
- Sen Gupta, M. C., M.Sc., Ph.D., Senior Organic Chemist, Dept. of Pharmacology, Haffkine Institute, Bombay.
- Sen Gupta, (Mrs.) Nilima, 2, Bepin Pal Road, Calcutta 26.
- Sen Gupta, (Miss) Phulrani, Professor of Geography, Lady Brabourne College, P 1-2, Suharwardy Avenue, Calcutta.
- Sen Gupta, S., M.Sc., Chemical Dept., Medical College, Calcutta.
- Sen Gupta, Sukumar, Superintendent of Agriculture, Anderson House, Alipore, Calcutta 27.
- Sen Gupta, S. B., D.Sc., Chief Chemist, Standard Pharmaceutical Works Limited, Calcutta 14.
- Sen Gupta, Subodh Kumar, M.Sc., Mycological Assistant, 230, Netaji Subhas Road, Tollygunge, Calcutta 33.
- Sen Gupta, (Dr.) S. R., Ph.D., M.B., D.P.H., F.C.S. (Lond.), Asst. Director of Health Services and Head of the School Hygiene and Nutrition Division, Govt. of West Bengal, Writers' Building, Calcutta.
- Sen Gupta, Sangram Ranjan, Technical Officer, Indian Jute Mills Association Research Institute, 3, Taratolla Road, Calcutta 27.
- Sen Roy, A. K., Chief Chemist, Hall & Anderson, Chowringhee Road, Calcutta.
- Seshachar, (Mrs.) B. R., C/o. Dr. B. R. Seshachar, Professor of Zoology, Central College, Bangalore.
- Shah, Ghanshyamlal M., Chemist, The Pitlad Turkey Reddy Works, Petlad (via Anand).
- Shah, (Dr.) S. M., M.A., Ph.D. (Lond.), F.A.Sc., Reader in Mathematics, Muslim University, Aligarh.
- Sharma, S., M.Sc., Ph.D. (Engg.) (Lond.), A.M.I.E.E., A.M.I.E., Assistant Professor of Electrical Engineering, Bihar College of Engineering, Mahendra P.O., Patna 6.
- Shanta, K. P., Asst. Research Officer (Soil), Soils Laboratory, U. P. Irrigation Research, Bahadradabad, Saharanpur Dist.
- Sharma, A. K., Botany Dept., University of Calcutta, 55, Ballygunge Circular Road, Calcutta.
- Sharma, K. D., Senior Scientific Officer, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
- Sharma, (Prof.) Ram Krishna, M.Sc., Professor of Chemistry, S. D. College, Ambala Cantt.
- Sharma Ram Sawrup, C/o. Instruments & Chemicals Ltd., Ambala Cantt.

- Sharma S. L., M.Sc., Central Sugarcane Research Station, Pusa.
- Sharma, S. N., M. Pharm., Asst. Professor, Dept. of Pharmaceutics, Benares Hindu University, Benaras.
- Shome, (Miss) N.B., 76A, Chakraveria Road, Calcutta.
- Shome, M. L., 1, Council House Street, Calcutta.
- Shirole, B.G., Phergusan College, Poona.
- Shrivastava, H. N., Additional Chief Engineer, Posts & Telegraphs, Jabbalpore.
- Shroff, T. R., Testing Dept., Tata Hydroelectric P. S. Co., Ltd., Lalwadi, Bombay 12.
- Shrenfels, (Dr.) U. R., Dept. of Geography, University of Madras, Madras.
- Shareef, Azmatullah, Dept. of Zoology, Osmania University, Hyderabad-Dn.
- Siddhanta, Susil Kumar, M.Sc., Professor of Chemistry, Presidency College, Calcutta.
- Singh, B. N., D.Sc., F.N.I., Crop Physiologist to Govt. of United Provinces, Institute of Crop Physiology, Butler Palace, Lucknow.
- Singh, M. K., Instruments & Equipments, 42, Dharamtala Street, Calcutta 13.
- Singh, K. B., M.Sc., Ph.D. (Edin.), Animal Genetics, Livestock Research Station, Mathura.
- Singh, K. N., M.A., B.L., Sahityaratna, M.R.A.S. (Lond.), Ashutosh College 9, Russa Road (Morning Section), Calcutta.
- Singh (Dr.) S. N., Head of the Dept. of Zoology, Osmania University, Hyderabad-Deccan.
- Sinha, P. C., L.E., A.M.A.E., Sleeper Passing Officer, Eastern Group, Katihna, Purnia Dist., Bihar.
- Sinha, (Dr.) P. C., Professor of Inorganic Chemistry, Science College, Patna 5.
- Sinha, Subrata, B.Sc. (Cal.), 37-B, Ballygunge Place, Calcutta 19.
- Sinha, (Miss) Sashi Lata, Lecturer in Psychology, Women's College, Circular Road, Ranchi.
- Sitakumari, (Miss) B. V., Patna Women's College, Bayley Road, G. P. O., Patna, Bihar.
- Srinivasan, A., B.E., M.Sc., M.S., Mem.A.I.E.E., etc., Professor of Electrical Engineering, College of Engineering, Anantapur.
- Singha, D.B., Lecturer, Calcutta University,
- Silas, E. G., Zoological Survey of India, Calcutta.
- Singhal, S. N., M.A., 16, Sastitola Road, Calcutta 11.
- Siddigi, Omarali.
- Singh, H., 89, Netaji Subhas Road, Calcutta.
- Sibpuri, T.N., 2B, Lord Singha Road, Calcutta.
- Singh, B.N., Defence Science Laboratory, New Delhi.
- Sowhney, R.C., C.S.I.R., Delhi
- Soota, T. D., Zoological Survey of India, Calcutta.
- Sodhi, Jaswant Singh, F.C.S. (Lond.), B.A. (Hons.), Top Floor, Plaza Cinema, Connaught Place, New Delhi 3.
- Solapurkar, L. M., Manager, Howrah Oil Mill Ltd., 34-1, Bon Behari Bose Road, Howrah.
- Srinivashacharlu, Dept. Chem. Tech., Osmania University.
- Srinivashan, P., Bangalore.
- Srivastava, G. P., M.Pharm., Asst. Professor of Pharmacy, Dept. of Pharmaceutics, Hindu University, Banaras.
- Srivastava, J. G., Dept. of Botany, Science College, Patna 5.
- Srinath, (Dr.) K. V., Cyto-genetiest. Jute Agriculture Research Institute, Hooghly, West Bengal.
- Srivastava, Lal Mohan, Central Laboratories for Scientific & Industrial Research, Narayanguda Section, Hyderabad-Deccan.

- Sreenivasaya, M., B.A., F.I.I.Sc., F.A.Sc., Asst. Professor of Fermentation Technology, Indian Institute of Science, Bangalore 3.
- Srivastava, P.L., D.Phil. (Oxon.), F.N.I., Reader in Mathematics, Allahabad University, Allahabad
- Srivastava, (Mrs.) P. L., 5, Lajpatrai Road, New Katra, Allahabad.
- Sree Kissen Dutt & Co., Manufacturers of Preserved Foods, 128, Middle Road, Entally, Calcutta.
- Subramaniam, V, Superintendent, Cardite Factory, Aruvankadu.
- Sur, Krishnadas, Barasat, Chandernagar.
- Superintendent, Bengal Tanning Institute, Calcutta 15.
- Subrahmanyam, K., Asst. Professor of Bio-chemistry, S. C. B. Medical College, Cuttack.
- Sundaram, R. N., C/o. Sri V. A. K. Rangon, 5, Gopalakrishna Road, Thyagarayanagar P.O., Madras 17.
- Sukhdeo, C/o. Toshniwal Bros. Ltd., 4th Floor, Janmobhoomi Chambers, Ballard Estate, Fort Street, Bombay 1.
- Sui, Samadarshan, Managing Director, Sur Iron & Steel C., Ltd., 25-1, Convent Road, Entally, Calcutta.
- Surange, K. R., Ph.D. (Lucknow), Ph.D. (Cantab.), Reader, Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow.
- Sundarajan, (Dr.) A. R., Nutrition Research, Coonoor.
- Swami, S. Govinda, B.A., M.Sc., Asst. Cytologist, Banana Research, M. A. C. S. Laboratory, Law College Building, Poona 4.
- Swarup, (Miss Dr.) Sushila Shyam, Asst. Research Officer, Under I. C. M. R., Safdarjag Hospital, New Delhi.

T

- Tainsh, H. R., M.A. (Cantab.), B.Sc. (Lond.), F.G.S., Senior Geologist, Burmah Oil Co., C/o. Assam Oil Co., Ltd., Digboi.
- Talwalkar, S. S., T. Walkers Pharm. Laboratories, 680, Shuprewar, Poona 2.
- Tamhankar, R. V., Research Metallurgist, Research Laboratories, Tata Iron & Steel Co., Ltd., Burmahines P.O., Jamshedpur.
- Thakkar, C. D., Managing Director, Standard Pharmaceuticals Ltd., 67, Suresh Sarkar Road, Calcutta 14.
- Thatte, (Dr.) V. N., Dean Faculty of Science, College of Science, Nagpur.
- Thomas, (Prof.) S. L., St. Berchman's College, Changanacherry, Trivancore-Cochin.
- Thapar, (Mrs.) P., C/o. Dr. G. S. Thapar, M.Sc., Ph.D., Officer-in-Charge, Indian Council of Agriculture Research, Lucknow University, Lucknow.
- Tilang, M.A., Bombay.
- Tlechner, (Prof.) H., Indian Institute of Technology, Kharagpur, B. N. Rly.
- Tolpode, (Dr.) C. R., M.Sc., Ph.D., Dept. of Chemistry, Ferguson College, Poona 4.
- Toshniwal, (Mrs.) N., C/o. Toshniwal Bros. Ltd., Janambhoomi Chambers, Fort Street, Bombay 1.
- Toshniwal, (Mrs.) S., C/o. Toshniwal Bros. Ltd., Janambhoomi Chambers, Fort Street, Bombay 1.
- Trivedi, (Dr.) A. M., L. D. Arts College, and M. G. Science Institute, Navarangapur, Ahmedabad 9.
- Trivedi, B. S., Lecturer in Botany, University of Lucknow, Lucknow.
- Trivedi, D. M., Bombay.
- Trivedi, R. S., I.C.S., 5, Surendranath Banerjee Road, Calcutta 13.

Trivedi, T.K., College of Science, Botany Dept., Nagpur.
Tripathi, T.R., Central Fisheries, Barrackpore.

U

Urs, M. Mallaraj, B.Sc., B.Sc.Agric. (Edin.), Principal, Agricultural College, Hebbal, Bangalore.

V

Varshney, Y. P., M.Sc., A.R.I.C., Asst. Director, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
Vaidya, W.M., National Physical Laboratory, New Delhi.
Vaidya, (Mrs) S., National Physical Laboratory, New Delhi.
Vaidyanathan, K. S., Tata Iron & Steel Co. Ltd.,
Vakil, Madan Lal H, Indian Chemical Manufacturing Association.
Varma, R. S., Defence Science Laboratory, New Delhi.
Vedam. Jayam, All India Institute of Hygiene and Public Health, 110, Chittaranjan Avenue, Calcutta.
Vasu, H. D. M.Sc., Entomologist, Indian Agriculture Research Institute, Pusa, New Delhi.
Venkatesh, V., Geological Survey of India, 27, Chowringhee Road, Calcutta 13.
Verguise, J., Burmah Shell, Calcutta.
Vencole, S., M.Sc., Research Scholar, Osmania University, Central Laboratories, Narayanguda Section, Distillery Compound, Hyderabad-Deccan.
Venkatarao, H. S., B.Sc., Asst. Director of Sericulture, Champatna, South India.
Venkateswarlu, (Prof.) J., D.Sc., Ph.D. (Cantab), Professor and Head of the Dept. of Botany. Andhra University, Waltair.
Venkataraman, R., Superintendent, Fisheries Technological Section, Kozhikode, South India.
Veal, Erach Jehangirji, B.Ag., Ph.D. (Wales), etc., Officer-in-Charge, Plant Protection Products, Geigy Insecticides Ltd., 17A, Rustom Bagh, Flat No. 9, Victoria Road, Bombay 27.
Verma, (Mrs.) Neena, C/o. Mr. H. C. Verma, Grittin & Tatlock, 274, Hornby Road, Bombay.
Verma, S. S., Junior Scientific Officer, Central Glass y Ceramic Research Institute, Jadavpur College P.O., Calcutta 32.
Vihang, M. M. Parekh, 1031, Krishnanagar Road, Bhavnagar.
Viswanath, A., M.Sc. (Lond.), A.C.G.I., D.I.C., M.I.E., Principal, Anantapur Engineering College, 1, Cathedral Gardens, Madras.

W

Wakhaloo, S. N., M.Sc., Ph.D., Geology Dept., Patna University, Patna.
Whitaker, J. W., Director of Fuel Research Institute, Bihar.
Williams, H. (Major General), Engineer-in-Chief, Army Head Quarters, "Kashmir House", New Delhi.
Wood, Leonard, Managing Director, Hugh Wood Co., Digwarth.

Y

Yajnik, Jayant N., C/o. Dr. N. A. Yajnik, Principal, Sree Gujrat Samaj College,
Indore.

Z

Zipkes, E., Director, Research Institute, Central Road, Delhi.

LIST OF ASSOCIATE MEMBERS



- Abraham (Miss), 14/9, Jowtallah Road, Calcutta.
 Achari, V. S. Narasingh, 5, Esplanade East, Calcutta.
 Adhikary, A., 19, College Road, Calcutta.
 Aditya, Sukumar, Lecturer Chemistry Dept., Ravenshaw College, Cuttack
 Agarwala, B. K., C/o. B. Govindandhai Agarwala, Vakil, Katra Toll, Chandra Old City, Etawal.
 Agarwal, Har Prasad, 112/303, Swaroop Nagar, Kanpur.
 Ahmed, B. A., Golam, Lecturer in Zoology, Central College, Bangalore.
 Ahmed, S. M., Men's Field Colony,
 Alayar, (Miss) G. Ranga, C/o. The Director of Research, University of Travancore, Trivandrum.
 Ali, H., 51, Baithakkhana Road, Calcutta.
 Ali, S., 51, Baithakkhana Road, Calcutta.
 Amma, T. Pankajakshi, Asst. Chemist, Soil Survey Scheme, Central Research Inst. Trivandrum.
 Asolkar, (Mrs.) P., Nagpur.
 A. T. Jana, 18, Gobra Road, Calcutta.
 Ayan, Jnendramohan, Research Scholar, C.S.I.R., College of Engineering & Technology, Jadavpur.
 Ayanger (Mrs.), 22B, Nalini Sarkar Street, Calcutta.
 Ayar, P. V. Krishna, 70/71, G-Block, Dupuix Road, New Delhi.

B

- Bains, G. S., Central Food Technological Research Institute, V. V. Mohalla P. O., Mysore.
 Bami, (Dr.) H. L., Malaria Institute of India, 22, Alipore Road, Delhi 8.
 Banerjee, G. S., Bengal Veterinary College,
 Banerjee, A. K., 9/5, Nepal Bhattacharya Street, Calcutta 26.
 Banerjee, M., Bakulla House, Kidderpur.
 Banerjee, Paresh Nath, 61/3, Sikdar Bagan Street, Calcutta 4.
 Banerjee, B.N., 60-1, Harish Mukherjee Road, Calcutta.
 Banerjee, Aloke Kumar, 50-1, Dwanagaji Road, Pathakpara, Bally, Howrah.
 Banerjee, D., Science College, Palit Laboratory.
 Banerjee, Dharendra N., R. G. Kar Medical College, Calcutta.
 Banerjee, B.N., 2, Surendranath Banerjee Road, Calcutta 13.
 Banerjee, Gopal Chandra, 31B, Sankharitola Street, Calcutta.
 Banerjee, Ajit Kumar, Dept. of Zoology, University of Calcutta, 35, Ballygunge Circular Road, Calcutta 19.
 Banerjee, Arun Kumar, Dept. of Zoology, University of Calcutta, 35, Ballygunge Circular Road, Calcutta 19.

- Banerjee, Bimaladas, 48/1, Ramkanta Bose Street, Calcutta 3.
 Banerjee, Siddheswar, Atomic Energy Commission, 53, Pedder Road, Bombay 26.
 Banerjee, Satyendra Nath, Prof. of Chemistry, Narasingh Dutta College, Vill. Kalyanpur, P. O. Baruipur, Dist. 24-Parganas, West Bengal.
 Banerjee, Rabin, 22, Tagore Castle Street, Calcutta 6.
 Banerji, (Miss) Uttara, Flat No. 5, 9, Theatre Road, Calcutta 17.
 Banerji, N. G., Fuel Research Institute, Jealgora P. O., Manbhum.
 Baral, Sankar Sebak, Institute of Radio Physics & Electronics, 92, Upper Circular Road, Calcutta 9.
 Easu, Rashbehari, Jeogange, Murshidabad.
 Basu, Satuen, Presidency General Hospital.
 Basu, Ashis, D22, Govt. Housing Street, Calcutta 14.
 Basu, Chowdhury, Guruprasad, Science College.
 Basu, Probhas Kumar, Mycological Asst., State Agricultural Rech. Inst., 74, Bondel Road, Calcutta 19.
 Barak, Radharaman, Physiology Dept., Presidency College.
 Bardhan, Nihar Ranjan, 10, Haripada Dutt Lane, Calcutta.
 Barua, P.C., Tollygunge.
 Barman, Amiya Kr., P. O. Sirakul, 24 Parganas.
 Banik, T. C., 54, Hari Ghosh Street, Calcutta.
 Bagchi, Ranjit Kumar, Jalpaiguri College, Jalpaiguri.
 Baman, T.J., Public Health Laboratory, Poona 1.
 Bajpai, K.K., Science College, Calcutta.
 Bagchi, Tarak, 65-2-6, Raja Rajballav Street, Calcutta 3.
 Bera, Rajendra Kumar, 43/2A, Suburban School Road, Calcutta.
 Behari, D.D., 91, Vivekananda Road, Calcutta.
 Behani, Sushila, 91, Vivekananda Road, Calcutta.
 Bera, S.K., 43-2-A, Suburban School Road, Calcutta.
 Bengal Trading Stores Ltd., 22, Sukhla Lane, Calcutta.
 Bhattacharya, Anil, Lecturer-in-Chemistry, Surendra Nath College, 1/1, Bhairab Biswas Lane, Calcutta 6.
 Bhattacharya, N. N., Geologist Syndicate Limited, 646, Circular Road, P.O. Santragachi, Howrah.
 Bhattacharyya, P. B., Soil Biochemist, Sugarcane Rech. Station, Pusa, Darbhanga.
 Bhatnagar, Jagdish Narain, Senior Scientific Assistant, Fuel Research Institute, Jealgora P. O., Manbhum.
 Bhar, M.N., Tropical School of Medicine, Calcutta.
 Bhowmick, (Mrs.) J., 15D, Maurice Nagar, Delhi University, Delhi.
 Bhowmick, Manojendra, Lecturer, Mechanical Engineering Dept., Jadavpur College, Calcutta 32.
 Bhskaran, R., Mukteswar, Kumaun.
 Bhatia, Baldev Singh, Central Food Technological Rech. Institute, V. V. Mohalla P.O., Mysore.
 Bhatia, (Dr.) D. S., Central Food Technological Rech. Institute, V. V. Mohalla P. O., Mysore.
 Bhaya, K. D., Research Asst. Animal Genetics Section, Indian Veterinary Research Inst. Izatnagar.
 Bhowmik, J. C., 69, Jadav Collony, Behala.
 Bhowmik, M. L., 12, Harachandra Mallick Street, Calcutta 5.
 Bhowmik, (Miss) Rohini Lata, 138, Ultadanga Road, Calcutta.
 Bhowmick, Haridas, 27, Badurbagan Lane, Calcutta.
 Bhaumik, Siteshbhusan, Physics Dept., Science College,

- Bhaumik, (Miss). Gouri, 7, Sardar Sankar Lane, Calcutta.
 Bhattacharjee, Harendra Narayan, 135, Canning Street, Calcutta.
 Bhaduri, Roma, 53-B, Southern Avenue, Calcutta 29.
 Bharati, Sallajanada, Gauhati University, Gauhati.
 Biswanathan, Chemical Engineer, Banaras Hindu University, Banaras.
 Biswas, Sanat Kr., 59, Sitaram Ghosh Street, Calcutta.
 Biswas, Manashi, 21, Hallwel Lane, Calcutta 9.
 Biswas, Sadabrata, 44/1, Malonga Lane, Calcutta.
 Biswas, Pankajashya, Research Asst., Horticultural Research Stn., Dept. of Agriculture, West Bengal, Krishnagar P. O., Nadia Dt.
 Biswas, Muralimohan, 171, Bowbazar Street, Calcutta 12.
 Biswas, Anil Baran, Geological Survey of India, 27, Chowringhee, Calcutta 13.
 Bose, A.K., Station Road, Bhatpara, 24-Parganas.
 Bose, Sukumar, 9/5A, Perry Mohan Sur Lane, Calcutta 6.
 Bose, Juthika, 2-6, Kanklia Road, Calcutta.
 Bose, Atindraya, Bose Institute, Calcutta.
 Bose, Debabrata, 92-3, Upper Circular Road, Calcutta.
 Bose, A., Indian Association for the Cultivation of Science.
 Bose, S.C., Dhar, Shudhansu Bhusan, National Tobacco Co., Agarpara.
 Bose, S. K., Prof. of Froensic Md. C. N. M. I. Calcutta National Medical Institute, Calcutta
 Bope, Camage Alber, Science College, Calcutta.
 Bosu, Tushar Kanti, 18, Pitambar Bhattacharya Lane, Calcutta.
 Bose, Asoke Kumar, Dept. of Zoology, University of Calcutta, 35, Ballygunge Circular Road, Calcutta 19.
 Boss, (Dr.) K. N., Fathpuri, Delhi.
 Brahma, Samir Kumar, Dept. of Zoology, University of Calcutta, 35, Ballygunge Circular Road., Calcutta 19.
 Bysakh, Bireswar, 55, W. C. Banerjee Street, Calcutta 6.

C

- Chacko (Miss) Anna M., Research Scholar, Central Research Institute, Trivandrum, Travancore.
 Chacko, (Dr.) L., Professor of Anatomy, Christian Medical College, Vellore.
 Chadha, M. S., Malaria Institute of India, 22, Alipore Road, Delhi.
 Chanda, Benoyendra, Lecturer, Mechanical Engineering Dept., College of Engineering & Technology, Calcutta 32.
 Chandhari, K. R., M.Sc., Physics Dept., Faculty of Science, S. J. Science Institute, Baroda.
 Chandra, (Dr.) K., Animal Nutrition Section, India Veterinary Research Inst., Izatnagar,
 Chandy, (Dr.) Miss. Mary, Dept. of Zoology, University of Delhi, Delhi.
 Chakravarti, Subodh Chandra, Lecturer, Dept. of Chemistry, Presidency College Calcutta.
 Chakrabarti, Rajat Kumar, Lecturer, Mechanical Engineering Dept., Jadavpur Engineering College, Calcutta 32.
 Chakravarti, R. K., Lecturer in Mathematics, Cotton College, Gauhati.
 Chakravarti, Sallaja Charan, 182, Panchanan talla Road, Howrah.

- Chakarabarty, A., 121, Gardener Road, Lilooah.
- Chakravarty, Bhabatosh, 17/1, Rati Sankar Lane, Calcutta.
- Chakrabarty, I. L., Bose Institute, 93, Uper Circular Road, Calcutta.
- Chakrabarty, A.K., Paddar Botanist, Haringhata Farm,
- Chakravarty, M., 41, Gopi Mohan Dutt Lane, Calcutta.
- Chakravarty, Sushil K., 15, Gourlaha Street, Calcutta 6.
- Chakravarty, Dilip, 72A, Padmapukur Road, Calcutta.
- Chakravarty, Saroj Ranjan, Dept. of Chemistry, Presidency College,
- Chakravarty, 18-35, Dover Lane, Calcutta 29.
- Chakrabarty, I.L., Bose Institute, 93, Upper Circular Road, Calcutta.
- Chakrabarty, Sailesh Ch., 22/1, Fern Road, Calcutta 19.
- Chakravarty, Umesh Chandra, 87, Amherst Street, Calcutta 9.
- Chaudhury, M., Dept., of Physics, University of Delhi, Delhi 6.
- Chaudhury, Kailash Chandra, 9A, Balmik Kundu Maccar Road, Calcutta-7.
- Chaudhuri, S.B., 31B, Badridas Temple Street, Calcutta.
- Chaudhury, J.K., 12, Bepin Pal Road, Calcutta—26.
- Chandra. Aloka, 18, Ritchie Road, Calcutta.
- Chawdhury, M. L., Indian Science Association,
- Chatterjee, K. M., Ukhra Post., Dt., Burdwan.
- Chatterjee, P.K., 31, Badridas Temple Street, Calcutta.
- Chatterjee, J., Scottish Church College, Calcutta.
- Chatterjee, H., Jute Technological Research Laboratory, Calcutta.
- Chatterjee, R. G., Psychology, Calcutta University, Calcutta.
- Chatterjee, B.N., 18, Ritchie Road, Calcutta.
- Chatterjee, Kalipada, 18A, Sri Gopal Mallick Lane, Calcutta.
- Chatterjee, Sunil Kumar, Chatterjee para, Sheoraphuli, Hooghly.
- Chatterjee, Probod K., 22, Bhagabati Chatterjee Street, Belgharia, Calcutta.
- Chatterjee, M.N., 21B, Nuff Street, Calcutta.
- Chatterjee, Amalesh, 1/A. S.K., Sarbadhikary Lane, Calcutta 10.
- Chatterjee, Bimal Bhusan, Demonstrator in Mathematics, B. E. College, Sibpur, Howrah.
- Chatterjee, Probodh Kumar, Lecturer in Physics,, B. E. College, Quarter No. 4, B. E. College, Howrah.
- Chatterjee, S. K., Geologists, Syndicate Limited, 56, Ritchi Road, Calcutta 19.
- Chatterjee, Sambhu Nath, Research Asst., Animal Genetics Section, Indian Veterinary Research Institute, Izatnagar.
- Chatterji, Sarat Chandra, Professor of Chemistry, Vidyasagar College, 39, Sankar Ghosh Lane, Calcutta 6.
- Chanda, Bhakti Lata, 8B, Bepin Pal Road, Calcutta.
- Choudhury, B. K., Central Sugarcane Research Station, Pusa P. O., Darbhanga.
- Choudhury, J. C., Research Asst., Mycology Section, State Agricultural Research Institute, 230, Netaji Subhas Road, Calcutta 33.
- Chowdhury, N. K., Asst. Chemical Examiner, Opium Factory, Ghazipur.
- Chowdhury, D. C., University College of Science, Calcutta.
- Chowdhury, B.N., 23, Baje Sibpur Road,
- Chowdhury, P., 83, Raja Rajballav Street, Calcutta 3;
- Chowdhury, Nirmal Baran, C/o. M. Bhattacharya & Co.
- Choksay, S.K., 47, Park Street, Calcutta.
- Chellamnia, J. V., Trivandram.
- Chowbe, Promode Nath, P103, Darga Road, Calcutta.
- Chottopadhyay, A. K., 101, Russa Road, Calcutta.
- Commen, (Miss) Mary, Mukteswar-Kumaun.

D

- Daggal, Avator N., Y.M.C.A., College Street, Calcutta 12.
- Das, Arabinda, Lecturer in Engineering, College of Engineering, Calcutta 32.
- Das, D. P., Central Food Technological Research Inst., V. V. Mohalla P. O., Mysore.
- Das, K. Ganesa, Lecturer in Chemistry, University College, Trivandrum.
- Das, M., 17, Sakharitola Street, Calcutta.
- Das, Ranendra Krishna, 31-C, Ram Mohan Saha Lane, Calcutta.
- Das, D. P., 22B, Park Side Road, Calcutta.
- Das, Suresh Chandra, I.A.R.I., New Delhi.
- Das, Sisir Chandra, Chandernagore College, Chandernagore.
- Das Kashi Nath, 19, S. N. Banerjee Road, Calcutta.
- Das, Paresh Nath, Lecturer in Communication Engineering, Bengal Engineering College, Sibpore, Howrah.
- Das, D. P., Dept. of Chemistry & Metallurgy, Bengal Engineering College, Howrah.
- Das, Samir Kumar, Research Scholar, 60A, Ritchie Road, Calcutta 19.
- Das Gupta, (Miss) Indrani, 10, Rawdon Street, Calcutta 16.
- Das Gupta, J., Midnapore College, Midnapore.
- Das Gupta, M. L., Associate Prof. of Electric Engineer, B. E. College, Howrah.
- Das Gupta, Sati, 1/6A, Dover Lane, Calcutta.
- Das, Gopi Nath, 19, S. N., Banerjee Road, Calcutta.
- Das Gupta, Amiya Kumar, National Tobacco Co., Agarpara.
- Das Gupta, C. R., 3/4, Bosepara Lane, Tallygunge, Calcutta 33.
- Das Gupta, P. B., 12/1, Selimpur Road, Dhakuria P. O.
- Das Gupta, B. N., Chemist, M. Bhattacharya & Co.,
- Das Gupta, Paresh Ch., Indian Association for the Cultivation of Science.
- Das-Gupta, N.P., C/o. D. C. Das-Gupta, Reader, Gauhati University, Assam.
- Dasgupta, K. P., 179/1, Cornwallish Street, Calcutta.
- Dasgupta. P. R., Department of Chemistry, Presidency College, Calcutta.
- Datta, Radhanath, Technical Asst., Atomic Energy, Commission, 49-B, Sikdarpara St., Calcutta 7.
- Datta, Shyamendu, Electrical Engineer, 74-1, Talpukur Road, Calcutta 10.
- Datt, Birendra Nath, 78B, Maniktalla Street, Calcutta.
- Dastidar, Satyajit Ghosh, 164C, Rashbehari Avenue, Calcutta.
- Dalal (Mrs), P398, Southern Avenue, Calcutta.
- Dey, A. K., 13/1, Bankim Chatterjee Street, Calcutta.
- Dey, Nirode Behari, 6A/1, Durga Pituri Lane, Calcutta 12.
- De, Kalidas, P129, Lake Tarace, Calcutta.
- De, M. L., P. O. Santragachi, Howrah.
- De. Ranjit K., Dept. of Anthropology, Indian Museum.
- De, Kamini Kr., 16, Convent Road, Calcutta 16.
- De, Anil Kumar, Chemical Engineering Dept., College of Engineering, Calcutta 32.
- De, (Mrs.) Shailaja, Indian Dairy Research Inst., Hosur Road, Bangalore 1.
- De, Sukumar, Indian Dairy Research Institute, Hosur Road, Bangalore 1.
- De, Satyendra Kumar, Geological Asst., Geological Survey of India, 27, Chowringhee, Calcutta 13.
- Deb, Asit Psychology Dept., University College of Science, 92, Upper Circular Road. Calcutta 9.
- Deb, (Mrs.) B. C., C/o. Sri M. K. Ganguly, 933-B, Shivagi Nagar, Poona 4.
- Debrai, Bal Govind, Senior Research Asst., Institute of Crop Physiology, 1-A, Sul-tanpur Road, Lucknow.
- Desarkar, B.K., Research Asst., Jute Agriculture Rech. Inst., Hooghly.

- Dev, S. G., Borosil Glass Works, Chotani Estate, Proctor Road, Near Grant Road, Bombay 7.
- Dhaygude, (Mrs.) Kamala, 4/2, Lansdown Road, Calcutta 20.
- Dhanaveer, Bombay Cumbellahall.
- Dhawan, Pramila, 189, Lansdown Road, Calcutta.
- Dhawn, Shukla, 189, Lansdown Road, Calcutta.
- Dhingra, Lekh Raj, Research Asst., Bacteriological Laboratory, Govt. Agricultural College, Ludhiana, Punjab.
- Dutta, (Mrs.) Lila, C/o. Sri Naren Dutta, National Chemical Laboratory, Poona 7.
- Dutta, Sunil Chandra, C/o. Sri Sarkar Selak Baral, Institute of Radio Physics and Electrics, 92, Upper Circular Road, Calcutta 9.
- Dutta, S.C., 33, Grey Street, Calcutta 6.
- Dutta, Sudhangshu K., Chandernagore College, Chandernagore.
- Dutta, Dilip Kumar, 13, Madhab Lane, Calcutta.
- Dutta, Santi, P1-1, Surabardi Avenue, Calcutta.
- Dutt, K.P., 1-6, Chanditola Lane, Calcutta 33.
- Dutt, B., Khaira Laboratory Science College,
- Dutt, S. P., 1, Hari Chran Banerjee Street, Belur Math.
- Dutt, D. M., Calcutta.
- Dutt, Sambhu Nath, 10-B, Lake View Road, Calcutta.

E

- Edwards, (Miss) O. S., Women's Christian College, Madras 6.

G

- Ganguli, M., Science College, Calcutta.
- Ganguli Hirendra Ch., Botany Dept., Presidency College, Calcutta.
- Ganguli, Nikunja Bhusan, P.48, B. K. Pal Avenue, Calcutta.
- Ganguli, (Dr.) J. R., 42, Ratendra Road, New Delhi
- Ganguly, (Mrs.) M. K., C/o. Sri M. K. Ganguly, 933-B, Shivaji Nagar, Poona 4.
- Gautam, Chittaranjan, Professor of Chemistry, Vidyasagar College, 39, Sankar Ghosh Lane, Calcutta 6.
- George, V. K., 14/9, Jhowtolla Road, Calcutta.
- George, (Mrs) M., Lady Brabourne College, Calcutta.
- Ghosh, Onkarnath, C/o. H. Ghosh, Manager, Raj Datta Colliery, P. O. Kanoragram, Dt. Burdwan.
- Ghose, K.C., L.M.F., 16, Loudon Place, Calcutta.
- Ghosh, Prosanta Kumar, 28/1B, Russa Road, Calcutta.
- Ghosh, Sachin, 1/19, Prince Gholam Mohd. Road, Calcutta.
- Ghose, T.N., 1, Bocotor's Lane, New Delhi.
- Ghose, Ramesh Chandra, 65, Brahma Samaj Road, Calcutta.
- Ghose, Anjali, 29-7, Golf Club Road, Calcutta.
- Ghosh, Arun Kr., 36, S. N. Roy Road, Sonarpur, 24 Parganas.
- Ghose, Provash Chandra, Vidyasagar College, Calcutta.
- Ghose, M.C., 80, J. N. Santra Lane, Howrah.
- Ghosh, Debabrata, Presidency College, Calcutta.
- Ghosh, Pronab Kumar, 62A, Hari Ghosh Street, Calcutta.
- Ghosh, Tarun K., College of Engineering & Technology, Jadavpur.

- Ghosh, P.K., C/o. N. C. Ghosh, Niranjani, 44, Gariahata Road, Calcutta.
- Ghosh, N.K., 134, Muktarām Babu Street, Calcutta 7.
- Ghosh, Ajit Kumar, 1, Bhabanath Sen Street, Calcutta 4.
- Ghosh, Abani Ranjan, Chemical Engineering Department, College of Engineering, Calcutta 32.
- Ghosh, (Miss) Amiyabala, 10, Rawdon Street, Calcutta 16.
- Ghosh, (Mrs.) Bani, Psychology Dept., University College of Science, 92, Upper Circular Road, Calcutta 9.
- Ghosh, Benoy Kumar, Geology Department, Presidency College, Calcutta 12.
- Ghosh, Dilip Kumar, 51, Badridas Temple Street, Calcutta 4.
- Ghose, (Mrs.) Gouri, Lecturer in Botany, Revenshaw College, Cuttack.
- Ghosh, Himanshu Sekhar, Accountant, Assam Bengal Cement Company, 20, Hazra Road, Calcutta 26.
- Ghosh, Kashinath, Howrah Jute Mill Power House, Ramkristopur, Howrah.
- Ghose, Subimal, 4, Justice Chandra Madhab Road, Calcutta 20.
- Ghosh, Subash Kumar, Chemical Laboratory, Presidency College, Calcutta.
- Ghosh, Saral Nath, 10, Kali Charan Sett Lane, Calcutta 30.
- Ghosh Majumdar, Subhendu, Demonstrator in Chemistry, Bangabasi College.
- Ghose, (Miss) Roma, 23B, Sardar Sankar Road, Calcutta 29.
- Ghosal, R. K., Central Sugarcane Rech. Station, Pusa P.O., Dharbhanga.
- Ghoshal, Bramha Baran, C/o. Sri Sankar Selak Baral, Institute of Radio Physics & Electrics, 92, Upper Circular Road, Calcutta 9.
- Gijare, L. P., 624, Sadasib, Poona 2.
- Goenga, Uma Sankar, 2/2, Harrington Street, Calcutta.
- Goswami, Nagen Ch., Gauhati University, Assam.
- Goswami, Satyandra N., Barasat College, Barasat.
- Goswami, Mohini Mohan, RS/SNP Hospital, Calcutta 20.
- Goswami, M., Textile Technical Laboratory, Town Hall, Calcutta.
- Gopalaswamy, S. N., Dept. of Pure and Applied Chemistry, General Chemistry Section, Indian Institute of Science, Bangalore.
- Gopinath, K., Marine Biological, Dept. of Marine Biology and Fisheries, University of Travancore, Trivandrum.
- Guha, H. K., Geologist Syndicate Limited, 137, Canning Street, Calcutta.
- Guha, (Miss) Maya, Dept. of Psychology, Science College, 92, Upper Circular Road.
- Guha, S. C., Geologists Syndicate Limited, 137, Canning Street, Calcutta.
- Guha, S. C., 12, Gandhi Road, Gwalior.
- Guha, (Mrs.) S. C., 12, Gandhi Road, Gwalior.
- Guha, Sailendra Kumar, Physics-Section-in-Charge, 66A, Park Street, Calcutta 17.
- Guho, Manik, 35, Karbala Tank Lane, Calcutta.
- Gupta, M. G. Research Assistant, General Rech. Section, H. B. Technological Institute, Kanpur.
- Jupta, P. P., Lecturer in Agriculture, Peoples Industrial and Agricultural School, Domariganj, Basti.
- Gupta, Y. K., Lecturer in Chemistry, D. A. V. College, Kanpur.
- Gupta, A. K., Central Rice Research Institute, Orissa.
- Gupta, (Mrs.) T. C., Darbhanga Medical College, Darbhanga.
- Gupta, Bani, P89, Lake Road, Calcutta.
- Gupta, Amar Prasad, 7, Middleton Street, Calcutta—16.
- Gupta, Asim Kumar, 6, Rev. Kali Banerjee Row, Calcutta.
- Gupta, Kamal Kumar, Sarada Chran Museum, P. O. Sheoraphully, Dt. Hooghly.
- Gupta, Namita, Victoria Institution, Biology Department, Calcutta.
- Goopta, Naranarayana, 5, Middleton Street, Calcutta 16.

H

- Halder, D., Hindus Hostel, Calcutta.
 Handique, B. K., Hindu Hostel, Calcutta.
 Haque, Masudul, Lecturer in Anatomy, Medical College, Patna.
 Halder, Gobindalal, 14, Sibnarayan Das Lane, Calcutta 6.
 Hafez, M. A., Lecturer in Psychology, Maharajas College, Mysore.
 Hore, Pramath Nath, 7-2, Dover Lane, Calcutta.
 Hoon (Mrs) Rama, 81, Lansdown Road, Calcutta.

I

- Ingle, T. R., Poona.

J

- Jacob, (Mrs) T., Lady Brabourne College, Calcutta.
 Jain, N. K., 26, Market Road, Delhi.
 Jain, GR., Victoria College, Goalior.
 Jain, Nagina Lal, Central Food Technological Rech. Inst., V. V. Mohalla P.O., Mysore.
 Jalote, S. R., Senior Research Assistant, Institute of Crop Physiology, 1-A, Sultanpur Road, Lucknow.
 Johari, M. P., Animal Genetics Section, Indian Veterinary Rech. Institute, Izatnagar.
 John, (Miss) Mary, Marine Biologist, Dept. of Marine Biology and Fisheries, University of Travancore, Trivandrum.
 Johri, Lakshmi Narain, Dept. of Zoology, University of Delhi, Delhi 8.
 Johri, P. N., Animal Nutrition Section, Indian Veterinary Rech. Inst., Izatnagar.
 Johari, G.P., Indian Institute of Technology,
 Joneja, K. L., Senior Rech. Asst., Central Sugarcane Rech. Inst., Patna.
 Joseph, K. V., Entomologist, Central Research Inst., Trivandrum.
 Joseph, P. T., Lecturer in Chemistry, Intermediate College, Trivandrum.
 Joshi,

K

- Kapoor, H.P., Lecturer, U. P. College of Veterinary Science and Animal Husbandry, Mathur.
 Kararia, Gopi K., 157, Chittaranjan Avenue, Calcutta.
 Kashyap, (Miss.) Annapurna, 45, Armenian Street, Calcutta.
 Kagi, Likohon Ch., Gauhati University, Gauhati.
 Kar, Santosh, 160, Maszid Bari Street, Calcutta.
 Kar, Subhrendu, 55, Mirzapur Street, Calcutta 9.
 Katriwal, Bhuramal, Scottish Church College, Calcutta.
 Kent, S. S., Chief Medical Officer's Office, East Indian Rly., Calcutta.
 Kershwaha, N. S., Animal Genetics Section, Livestock Rech. Station, Mathur.
 Khan, (Miss) Ava, 15, Lansdown Terrace, Calcutta.
 Kher, Harkrishna Lal, 173, Park Street, Calcutta 17.

- Khosla, R. R., Fuel Research Institute, Jealgora P.O., Manbhum.
 Krishnaswamy, N., Agricultural College and Rech. Inst., Lawley Road, Coimbatore.
 Krishnaswami, 15-1, Chowringhee Square, Calcutta.
 Kulkarni, V. G., Empire Hindu Hotel, Bombay 1.
 Kurien, C. V., Fresh Water Biologist, Ayiramthengu, Kayamkulam.
 Kumari, (Mrs.) Rasam, 59, Ballygange Main Road, Calcutta.
 Kulkarim, S. V., 146, Chittaranjan Avenue, Calcutta.
 Kundu, G. C., Science College, 92, Upper Circular Road, Calcutta.
 Kundu, Sunil Kumar, Presidency College, Calcutta.

L

- Lahiri, G. P., Asst. Engineer, I.E.W., Ltd., Calcutta.
 Lahkar, D., 11D, Nassiruddin Road, Calcutta.
 Laik, Gorachand, Scottish Church College, Calcutta.
 Lahiri, Kalidas, Prof. of Calcutta National Medical College, Calcutta.
 Lahiri, Ajit Kr., 112, Chittaranjan Avenue, Calcutta.
 Lal, S. B., 23, Indra Biswas Road, Calcutta.
 Lal, Girdhari, Asst. Director, Central Food Technological Rech. Institute, V. V. Mohalla P.O., Mysore.
 Lal, Giri Saran, Demonstrator in Bio-chemistry, U. P. College of Veterinary Se., Mathura.
 Lakshmi, (Mrs.) V., C/o. Prof. M. V. Sitaraman, 24, Deivasigamani Muddi Street, Madras.
 Luktuke, S. N., Indian Veterinary Research Institute, Izatnagar.

M

- Mahadevan, T. D., Poultry Research Section, Indian Veterinary Rech. Inst., Izatnagar.
 Mazumdar, Mukul R., Physics Sept., Presidency College, Calcutta.
 Mathai, A. O., University of Trivancore.
 Mathai, G., Zoological Survey of India.
 Maity, Ajit, Physiology Dept., Science College, Calcutta.
 Matilal, B. M., 19/1A, Durgapituri Lane, Calcutta.
 Mathur, B. C., Banaras Hindu University, Banaras.
 Mathur, R.P., T.M.C.A., Calcutta 14.
 Mathur, S. P., Banaras Hindu University, Banaras.
 Mallick, Samarendra Chandra, 9A, Balaram Bose 1st. Lane, Calcutta.
 Mallik, N., Central Sugarcane Rech. Station, Pusa P. O., Darbhanga.
 Majumder, Kanak, 92, Upper Circular Road, Calcutta.
 Mazumdar, Amiya Kumar,
 Majumdar, Bagala K., 52, Harisson Road, Calcutta.
 Majumdar, Robin, Presidency College, Calcutta.
 Majumdar, (Mrs.) Bibha, C/o. Dr. R. C. Majumdar, Delhi University, Delhi 8.
 Majumdar, Gitika, Dept. of Zoology, University of Calcutta, 35, Ballygunge Circular Road, Calcutta 19.
 Mammen, (Miss) T. A., Marine Biologist, Dept. of Marine Biology and Fisheries, University of Travancore, Trivandrum.
 Merchant, D. E., Tropical School of Medicine, Calcutta.

- Mehra, Jai, House No. 18, University Colony, Gauhati,
 Mitra, Charubala, 5, Ram Mohon Roy Road, Calcutta.
 Mitra, Anadinath, Prof. of Chemistry, R.G. Kar Medical College, Calcutta
 Mitra, Partha Sarathi, Presidency College, Calcutta.
 Mitra, S.C., Indian Association for the Cultivation of Science.
 Mitra, Phani Bhusan, Chandernagore College, Chandernagore.
 Misra, A. N., Govt. Sugarcane Research Station, Shahajahanpur.
 Mitra, A. N., Dept. of Physics, University of Delhi, Delhi.
 Mitra, Biswanath, 57-9, Raja Dinendra St., Calcutta 6.
 Mitra, Biswas Nath, Dept. of Zoology, University College of Science, 35, Ballygunge
 Circular Road, Calcutta 19.
 Mitra, D. K., Prof. of Chemistry, Manindra Chandra College, Calcutta.
 Mitra, Jatindra Nath, 2, Dum Dum Road, Upper Flat, Main Building, Calcutta 30.
 Mitra, (Mrs.) R. P., C/o. Dr. R. P. Mitra, Delhi University, Delhi 8.
 Mitra, (Miss) Rekha, C/o. Sri Naren Dutta, National Chemical Laboratory, Poona 7.
 Mohan, T. R., 19, Jatin Das Road, Calcutta.
 Moitra, Sankarcherjee, Sulekha Works, Calcutta 32.
 Modak, G. K., 11, Creek Lane, Calcutta 14.
 Mondal, Lakshmi Narayan, 93H, Beltola Road, Calcutta 25.
 Moojani, N. M., Central Food Technological Rech. Inst., V. V. Mohalla P.O., Mysore.
 Moorthy, K. N., Central Laboratories for Scientific and Industrial Rech. Jamiah
 Osmania, Hyderabad.
 Mozumdar, Aruna,
 Moses, V., C/o. Tide Water Oil Co. (India) Ltd., 8, Clive Row, Calcutta.
 Mookherjee, Samarendra N., Asst. Statistical Officer, Directorate of Agriculture,
 Writers Buildings, Calcutta.
 Mukherjee, P., Bengal Veterinary College, Calcutta.
 Mukherjee, Manindra Nath, 16, Lake View Road, Calcutta 29.
 Mukherjee, Sudhansu, 32, Radha Kanta Ghosh, Calcutta 4.
 Mukherjee, B., 109-34, Hazra Road, Calcutta.
 Mukherjee, Usha, C/o. Dr. R. Mukherjee, Biochemist, Mukteswar, Kumaun, U.P.
 Mukherjee (Mrs.), 53, Princes Park Hostel, New Delhi.
 Mukherjee, D., Dum Dum Matijhil College, Calcutta.
 Mukherjee, Arun Kr., P52, B. K. Pal Avenue, Calcutta 5.
 Mukherjee, G., 192, Cornwallis Street, Calcutta.
 Mukherjee, B. C., Animal Genetics Section, Livestock Rech. Station, Mathura.
 Mukherjee, (Dr.) D. P., Animal Genetics Section, Indian Veterinary Rech. Inst.,
 Izatnagar.
 Mukherjee, Prabhat Charan, 2, Nayaratna Lane, Calcutta 4.
 Mukherjee, S. K., Lecturer, University College of Science, 92, Upper Circular Road,
 Calcutta 9.
 Mukherjee, Sailendra Mohan, Geology Department, Presidency College, Calcutta.
 Mukherjee, Tapan Kumar, Electrical Engineer, 1-A, Ekdalia Place, Calcutta 19.
 Mukerjee, B. C., 20A, Sri Radhanath Mallik Lane, Calcutta.
 Mukerjee, G. K., 23/53, Gariahata Road, Calcutta.
 Mukerjee, A. B., C/o. P. C. Mukerjee,
 Mukherji Amiya Charan, 2, Nayaratna Lane, Calcutta 4.
 Mukherji, Chandra Madhav, 31-1A, Govindo Bose Lane, Calcutta 25.
 Mukherji, (Mrs.) G., 10, Rawdon Street, Calcutta 16.
 Mukherji, M. R., 10, Rawdon Street, Calcutta 16.
 Mukhopadhyaya, (Mrs.) Khama, Lecturer in Mathematics, Intermediate College for
 Girls, Asansol.

Murarka, Narashingh P., 17, Bhawani Datt Lane, Calcuttta.
 Muhikar, Poona.
 Murti, B. V. Ramanan,
 Murti, J. V., Shyamnagar, 24 Parganas.

N

Nair, (Miss) G. Sivanllinttar, C/o. The Director of Research, University of Trivandrum, Trivandrum.
 Nair, K. N. Gopinathan, Chemist, Essential Scheme, Central Research Institute, Trivandrum.
 Nair, V. V., Ananda Bhaban Hotel, C. R. Avenue, Calcutta.
 Nair, K. V. Krishnan, Research Asst., Division of Mineral Survey and Research, Central Research Institute, Trivandrum.
 Nair, (Miss) M. R. Gopalallutman, C/o. The Director of Research, University of Trivandrum, Travancore.
 Nair, (Dr.) S. R., Whiteaway Building, Hornby Road, Bombay.
 Narain, R. D., Karnatak University, Dharwar.
 Narain, R., Research Asst. Poultry Rech. Section, Indian Veterinary Rech. Inst., Izatnagar.
 Narasimhan, M. D., Central Laboratories, Jama-i-Osmania P.O., Hyderabad-Deccan.
 Narasimhan, N. Y., Near Arya Nivas, Mithapur, Patna.
 Narayan, S., Poultry Rech. Section, Indian Veterinary Rech. Inst., Izatnagar.
 Narayanaswami, T., Christian Medical College, Vellore N.A.
 Natarajan, C. P., Central Food Technological Rech. Inst., V. V. Mohalla P.O., Mysore.
 Nayak, Manindranath, C/o. Sri Sankar Sebak Baral, Institute of Radio Physics & Electronics, 92, Upper Circular Road, Calcutta 9.
 Nath, Nanlini Kanta, 54, Bowbazar Street, Calcutta.
 Naidu, T.V.R.N., University Engineer, Waltair.
 Nath, Jyotirindra, Indian Association for the Cultivation of Science,
 Natarajan, M.N., Health Home, Karai Kundu, S. India.
 Nag, Ajit Kumar, 39B, Dilkhusa Street, Calcutta.
 Nag, S. K., 10/1B, Indra Roy Road, Calcutta 25.
 Nag, Tara Das, Jute Agricultural Research Institute, Chawk Bazar, Hooghly.
 Neogi, D., Dept. of Geology & Geo-physics, Indian Institute of Technology, Hijli, Kharagpur.
 Neogy, Rajat Kumar, 122, Linton Street, Calcutta 14.
 Nirula, Kanwal K., Entomologist, Central Coconut Rech. Station, Ochira P.O., Travancore.

O

Orient Traders & Co., 16 & 17, College Street, Calcutta.
 Osmani, R., C/o. Dr. S. H. Zaheer, Director, Central Laboratories, Jama-i-Osmania P.O., Hyderabad-Dn.

P

Pal, Asutosh, 3-1, Priyanath Mullick Road, Calcutta 25.
 Pal, (Dr.) A. K., P. R. Section, Indian Veterinary Research Inst., Izatnagar.

- Pal, R. C., Engineer, Lecturer in Electrical Engineer, B. E. College, Quarter No. 65, Howrah.
- Ial, Madhu Sudon, 71, Russa Road, Calcutta.
- Pal, Anil Krishan, 24, Beniatolla Street, Calcutta.
- Pal, Punna Chandra, C/. Bimala Rice Mills, 3. Gurudas Datta Garden Lane, Calcutta 4.
- Palit, S. J., Indian Hygine Public Health, 110, Central Avenue, Calcutta.
- Pandey, R. R., 84, Ashutosh Mokerjee Road, Calcutta.
- Panday, Lochan P., Civil Lines, Raigarh, B. N. Rly.
- Pandye, S. P., University of Delhi, Delhi 8.
- Panth, Sushila, 136B, Rashbehari Avenue, Calcutta.
- Pandit, J.L., Hindi High School, Calcutta 20.
- Pathak, Balaichand, Applied Chemistry, Science College, Calcutta.
- Paul, Bimal Chandra, 6/3, Hari Pal Lane, Calcutta.
- Parikh, N. M., Institute of Agriculture, Anand.
- Parthasarathy, M. D., Lecturer in Zoology, Central College, Bangalore 1.
- Patel, I.M., Institute of Agriculture, Anand, Dist. Kaira, N. Gujarat.
- Phukan, G. N., C/o. Assam Oil Co., Ltd., Digboi, Assam.
- Pillai, K. Velayudhan, Bacteriological Assistant, Public Health Laboratory, Trivandrum.
- Pillai, V. Ramkrishna, 'Seetha Saraz', Chenthitta, Trivandrum.
- Pocchali, Lochhu, Chemical Engineering Dept., Jadavpur Engineering College, Calcutta 32.
- Poddar, Sailen, 4/2, Amherst Street, Calcutta.
- Poddar, Sudhir Kumar, Vidyasagar Hostel,
- Poddar, A. P.,
- Poddar, H. P., Dept. of Anatomy, Medical College, Calcutta.
- Powvala (Miss) S., 5, Queen's Park, Ballygunge, Calcutta.
- Prabhu, S. S., Research Officer, Animal Genetics Section, Indian Veterinary Rech. Institute, Izatnagar.
- Prosad, Rajshwan, Central Sugarcane Rech. Station, Pusa, Darbhanga.
- Pramanik, D., 88/A, Hazra Road, Calcutta 26.
- Prova, (Miss) Shashi, 136B, Rashbehari Avenue, Calcutta.

R

- Raghabendra, V., Geological Survey of India, Calcutta.
- Rajagopalan, K. R., 16, S. N. Chetty Street, Madras-13.
- Rajan, S. V. Govinda, Agricultural Chemist, Dept. of Agriculture, Bangalore 2
- Rakshit, Sisir Chandra, Research Scholar, Calcutta University, 2, Ghosal Street, Flat No. 5, Calcutta 19.
- Ram, Gurdas, Central Water & Power Rech. Station, Poona.
- Ramchandran, M., Food Technological Section Indian Institute of Science, Bangalore.
- Ramkrishnan, T. A., Shark Liver Oil Factory, Trivandrum.
- Raman, V. S., Cytogenetics, Laboratory, Agricultural College & Rech. Inst., Lawley Rd., P. O., Coimbatore.
- Rane, K. S., Asst. Prof. of Electrical Engineering, Bengal Engineering College, Howrah.
- Rangan, L. Kasturi, Dept. of Physics, University of Delhi, Delhi 8.
- Rawat, J. S., Lecturer in Bio-chemistry, U. P. College of Veterinary Sc., Mathura.
- Ramachandran, K. N., Basabamgudia, Bangalore 4.

- Rao, M. V. Lakshminarayan, Central Food Technology Research Institute, Mysore.
- Rao, P.N., Indian Association for the Cultivation of Science, Jadavpur.
- Rao, B. Subba, Division of Entomology, Indian Agriculture Rech. Inst., New Delhi.
- Rao, B. S., Narayana, Research Scholar, Central Laboratories, Jamai-i-osmania P.O., Hyderabad-Dn.,
- Rao, B. V. Venkata, Chemistry Section, Dept. of Agriculture, Bangalore.
- Rao, C. N., Anantasubha, Section of Economics & Science, Indian Institute of Science, Bangalore 3.
- Rao, D. V. Ramana, Lecturer in Chemistry, Ravenshaw College, Cuttack.
- Rao, G. N. Subba, Central Food Technological Rech. Inst., V. V. Mohalla P. O., Mysore.
- Rao, H. G. Gopala, Asst. Chemist., Dept. of Agriculture, Bangalore.
- Rao, H.S., Senior Scientific Asst., Fuel Research Institute, Jealgorah P.O., Manbhum.
- Rao, M. A., Bangalore.
- Rao, S. K. Ramchandra, Research Asst., Dept. of Soil Sciences, Indian Institute of Science, Bangalore.
- Rao, V. S., Prof. of Botany, R. R. College, Bombay 19.
- Rao, V. Sitarama, Addl. Prof. of Anatomy, Madras Medical College, Madras.
- Ray, (Mrs.) Bina, Lady Irusin College, New Delhi.
- Ray, B. K., 28, Kali Kumar Banerjee Lane, Calcutta.
- Ray, B. K., 28, Kali Kumar Banerjee Lane, Calcutta.
- Ray, K. M., 115A, Ballygunge Gardens, Calcutta.
- Ray, P. K., C/o. N. K. Sen,
- Ray Chowdhury, 11/4, Kalicharan Ghosh Road, Calcutta 2.
- Ray, Rabindra Lal, 8C, Beadon Street, Calcutta 6.
- Ray, Prafulla Kr., 29, Strand Road, Calcutta.
- Ray, J., Indian Association for the Cultivation of Science.
- Ray, D. K., P302/1, Darger Road, Calcutta.
- Ray, R. K., Professor, Bangabasi College, Calcutta.
- Ray, Aniya Kumar, Research Workers, Fuel Rech. Inst., Jealgorah P. O., Manbhum.
- Ray, Chapalendu, 110, Vivekananda Road, Flat No. 7, Calcutta 6.
- Ray, Dharendra Chandra, Prof. of Chemistry, Vidyasagar College, Calcutta.
- Ray, K. K., Fuel Research Institute, Jealgora P. O., Mandhum.
- Ray, Nares Chandra, Prof. of Chemistry, Vidyasagar College, Calcutta 6.
- Ray, Ranajit, Public Relations Officer, 40/B, Lake Temple Road, Calcutta 29.
- Raye, S., 12, Simla Street, Calcutta.
- Roy, Kanailal, 9-6, Patuatola Lane, Calcutta—9.
- Roy, T.M., M.A., New Custom House, Calcutta.
- Roy Chaudhuri, Binoy, 3A, Haralal Das Street, Calcutta.
- Roy,, Shoke K., 64C, Hindusthan Park, Calcutta.
- Roy, P., Medicine Appraiser, New Custom House, Calcutta.
- Roy, Monomohan, 17, Gopikrishna Pal, Lane, Calcutta.
- Roy, Kamal Kr., 1-2B, Ballav Street, Calcutta 4.
- Roy Choudhuri, 3A, Haralal Das Street, Calcutta.
- Roy Chowdhury, Bimal, 134A, Lansdown Road, Calcutta.
- Roy, Anu Kumar, Geology Dept., Presidency College, Calcutta.
- Roy, Purna Chandra, C/o. Prof. S. S. Guha, Sircar, Prof. of Organic Chemistry, Ravenshaw College, Cuttack.
- Roy, P. K., Senior Rech. Asst., Central Sugarcane Rech. Station, Pusa, Darbhanga.
- Roy, Sudhir Chandra, Service Asst. Analyst, West Bengal Public Health, Laboratory, Calcutta 12.
- Roy Chaudhury, B., Post Box 136, Patna.

Roy Chaudhury, (Mrs.) Swarna Kumari, 10, Ballygunge Gardens, Calcutta 19.
 Rout, Mohendra Kumar, C/o. Prof. S. S. Guha Sircar, Prof. of Organic Chemistry,
 Ravenshaw College, Cuttack.

S

Saha, A. A., Dept. of Radio Physics and Electronics, University College of Science,
 92, Upper Circular Road, Calcutta 9.

Saha, (Mrs.) Indulekha, 9/C, Rajpur Quarters, Delhi 8.

Saha, S. K., Animal Genetics Section, Livestock Rech. Station, Mathura.

Saha, T., 5/17, Western Extn. Area, Karolbagh, New Delhi.

Saha, K.R., 12-1, Kiatola Lane, Calcutta 29.

Saha, S. N., 122C, Rashbehari Avenue, Calcutta.

Saha, Motilal, Ford Technical Dept., Collège of Engineering & Technology.

Saha, A. K., Dept. Surg., N. S. Med. Calcutta.

Saha, Radhasyam, Prof, The Assam Research Chemicals, Gauhati.

Saha, P.K., Ph.D., Technological Research Laboratory, Regent Park, Tollygunge.

Saha, Abinas Chandra, 4C, Sita Ram Ghosh Street, Calcutta 9.

Saha, B. N., 22/1A, Russa Road, Calcutta.

Sama, Basudev Das, Lecturer, Dept. of Pure Chemistry, University College of
 Science, 92, Upper Circular Road, Calcutta 9.

Sercar, Amal Kumar, Dept. of Zoology, University of Calcutta, 35, Ballygunge
 Circular Road, Calcutta 19.

Sarkar, (Mrs.) Niharkana, C/o. Prof. I. B. Sarkar, Professor Para, Gauhati.

Sarkar, Dinendranath, 29, Lansdown Place, Calcutta.

Sarkar, N. N., 7A, Dover Road, Ballygunge, Calcutta.

Sarkar, Kanailall, 37, Canning Street, Calcutta.

Sarkar, Asoke Kr., David Hare Training College,

Sarkar, Sakti Prosad, Lecturer in Zoology, City College, Calcutta.

Sarkar, (Mrs.), Science Congress Pandal, Presidency College, Calcutta.

Sarkar, (Miss) A., Lecturer in Physics, Bethune College, Calcutta.

Sarkar, (Miss) S., City, College, Calcutta.

Sastry, K. N. Sarma, Indian Association for the Cultivation of Science, Jadavpur.

Sastry, M.V.C., Indian Institute of Technology, Kharagpur.

Samanta, S.K., 2, Gurusadaya Road, Calcutta.

Sanyal, A.C., 22, Gopal Ch. Bose Lane, Calcutta.

Sant, (Mrs.) Shanta, 4/2, Lansdown Road, Calcutta 20.

Santani, Saurabh, Physics Dept., Presidency College, Calcutta.

Sahai, B., Animal Genetics Section, Indian Veterinary Rech. Inst., Izatnagar.

Sahib, C. Bhimasena Rao, Section of Economics & Social Science, Indian Institute of
 Science, Bangalore 3.

Samuel, C. K., Indian Agricultural Rech. Inst., New Delhi.

Saradamma, P., Research Assistant, Division of Applied Chemistry, Central Rech.
 Institute, Trivandrum.

Sarma, Byomakes, Bose Institute, 93, Upper Circular Road, Calcutta 9.

Saxena, B. S., Lecturer in Mathematics, College of Engineering, Muslim Univer-
 sity, Aligarh.

Sarah, J., Sourie Pl. Guntur, Medical College.

Schragenheim, (Mrs.) Edith, Lecturer in Textile Technology, and German Language,
 7, Nasiruddin Road, Calcutta 17.

Sen, Narayan, Indian Agricultural Research Institute

- Sen, Kalyanmoy Sen, Charu Chandra College,
 Sen, D. R., 27, Southern Avenue, Calcutta.
 Sen, Probhat Chandra, 171, Park Street, Calcutta 17.
 Sen, (Mrs.), 18, Madon Mitra Lane, Calcutta.
 Sen Gupta, Anantamohon, 178-A, Harish Mookerjee Road, Calcutta.
 Sen, Chittaranjan, Victoria Institute, Calcutta.
 Sen, Narendranath,
 Sen, Jnanendranath, Professor of City College, Calcutta.
 Sen, (Mrs.) Rama, 81, Lansdown Road, Calcutta.
 Sen, Bholā Nath,
 Sen, G.C., 46-5A, Ballygunge Place, Calcutta—19.
 Sen, Rajat Ch., 51, Theatre Road, Calcutta 17,
 Sen, Kumkum Kumar, Chandernagore College, Chandernagore.
 Sen Gupta, Purniam, P.39, Monohar Pukur Road, Calcutta 29.
 Sen, Ajit, Production Assistant, Reliance Firebrick Works (Andrew Yule & Co.),
 Barakar.
 Sen, A. N., Chemistry Division, Indian Agriculture Rech. Inst., New Delhi 12.
 Sen, Brojesh Chandra, C/o. Mr. B. B. Sen, 15/6, Deodarn Street, Block 'B,' Calcutta 19.
 Sen, Debabrata, 47/4, South Sinthee Road, Calcutta 2.
 Sen, Dabendra Nath, Calcutta.
 Sen, (Miss) Krishna, 179/1, Cornwallis Street, Calcutta.
 Sen, Prabhat Kumar, 31/F, Narkeldanga Main Road, Calcutta 11.
 Sen, (Mrs.) Rekha, C/o. Sri Ajit Sen, Production Asst., Reliance Firebrick Works,
 Adrew Yule & Co., Barakar P. O.
 Sen Gupta, Anil Ranjan, 5-B, Kirtibash Lane, Kalighat, Calcutta 26.
 Sengupta, Arun, Govt. Dairy Farm, Haringhata.
 Sebastian, T. C., Lecturer, University College, Trivandrum.
 Seth, P. L., C/o. M/s. Henrys Clark & Co., Kent House, P-33, Mission Row Extn.,
 Calcutta.
 Shome, S. C., 41B, Sankhari Tolla Street, Calcutta.
 Sharma, K. N. Senior Agronomical Asst., Sugarcane Rech. Sub-Committee, Kurna
 Ghat, Gorakhpur.
 Sharma, S. L., Sugarcane Mycologist, Central Sugarcane Rech. Station, Pusa.
 Sharma, U. D., Research Asst., Animal Genetics Section, Indian Veterinary Re-
 search Institute, Izatnagar.
 Shankar, G., C/o. S. Chand & Co., Publishers Fountain, Delhi.
 Shendge, P. T., Central Rice Research Institute, Orissa.
 Shetty, K. S., De puty Director of Veterinary Dept., Hyderabad-Dn.
 Shivvani, G. A., Research Asst., Indian Veterinary Rech. Inst., Mukteswar.
 Singh, Chintamani, Demonstrator of U. P. College of Veterinary Sec., Mathura.
 Singh, S. K. Prof. & Head of the Dept. of Mathematics, D. S. College, Aligarh.
 Sinha, (Miss) Nilima, Demonstrator, Lady Brabourne College, P1/2, Suhrawardy
 Avenue, Calcutta 7.
 Sinha, N. G., Metallurgist, Mukund Iron & Steel Works Ltd., Bombay 15.
 Sinha, Probodh Ranjan, Chemical Engineering Dept., College of Engineering,
 Calcutta 32.
 Sinha, S. K., Lecturer, Dept. of Chemistry, Presidency College, Calcutta 12.
 Sinha, Tribeni Prosad, Prof. or Anatomy, Medical College, Bankipore, Patna.
 Sikdar, K. N., Vill. Vhaita, P. O. Burdwan.
 Siddhanta, Sunil Kumar, Ashutosh College, Calcutta.
 Sircar, Sachidulal, Scottish Church College, Calcutta.
 Sinha, Arabinda, 10, Haripada Dutt Lane, Calcutta.
 Sinha, N.S., C/o. Mr. S. Kar, 55, Mirzapur Street, Calcutta 9

Sour, Jnendra Mohan, Research Asst., Bengal Immunity Rech. Inst., 39, Lower Circular Road, Calcutta 16.

Srinivasan, Central Food Technological Research Institute, Mysore.

Srikhande, K. Y., Fuel Research Institute, Jealgora P. O., Manbhum.

Sukumaran, R., Medical College, Guntur.

Sud, (Mrs.) B. C., M/s. Salima Mar Products, Jhoriah.

Jadavpur.

Subrahmanyam, V. S., Osmania University,

Subramanyam, B. S., Fuel Research Inst., Jealgofah P. O., Manbhum.

Sundaram, A. K., Atomic Energy Commission, 53, Padder Road, Bombay 26.

Sundaresan, M. K., Dept. of Physics, University of Delhi, Delhi.

Sur, Sudhansu Kumar, Supervisor Chemists, Dept. of Food, 1/P, Middle Road, Calcutta 14.

Swami, H.N., Indian Association for the Cultivation of Science, Calcutta.

T

Tandon, H. P., Indian Veterinary Rech. Institute, Izatnagar.

Tantry, B. A. P., Physics Dept., Banaras Hindu University, Banaras.

Telanga, Subhoda, 12, Gardener Road, Calcutta.

Thaknol, B. M., Asst. Research Officer, Poultry Research Section, Indian Veterinary Research Institute, Izatnagar.

Thiruneelachar, M. J., Centra; Potato Research Institute, Patna.

V

Varma, Jagadish, Dept. of Physics, University of Delhi, Delhi.

Varier, N. S., Senior Chemist, Central Research Institute, Trivandrum.

Valyale, Felly, 11, Russa Road, Calcutta.

Vanaprao, C.J.R., 27, Chowringhee Road, Calcutta.

Venkatanarasimhaiah, C. B., Lecturer in Zoology, Central College, Bangalore.

Venkataraman, T. V., Division of Entomology, Indian Agriculture Rech. Institute, New Delhi.

Vevai, (Mrs.) Aloo Erach, No. 17-A/9, Rustom Bagh, Victoria Road, Bombay 14.

Vishnoi, Harsaran Singh, Dept. of Zoology, University of Delhi, Delhi.

Vohra, Balbir K., C/o. H. R. Mehra, 173, Park Street, Calcutta 17.

Verma, K.N., M.A., Nagpur Maha Vidyalaya, Nagpur.

W

Wadhawan, S. K. Defence Science Laboratory, N. P. S. Building, Pusa New Delhi 5.

LIST OF STUDENT MEMBERS

A

- Acharya, Arup, 33, Chandi Ghosh Road, Calcutta 33.
 Acherjee, Bidhan Prakash,
 Acharyya, Subhas Ch., Calcutta Medical College, Cal.
 Adhikary, Prasanta, R. G. Kar Medical College, Calcutta.
 Adak, Amarendra Kumar,
 Aggarwal, R.C., Research Scholar, Chemistry Dept., Lucknow University, Lucknow.
 Agni, M.P., Dept. of Chemistry, University of Poona, Poona.
 Agrwall, Sohan Lal, Geological Laboratory, Presidency College, Calcutta.
 Ali, Siddique, Dept. of Physics, Cotton College, Assam.
 Ali, M. Shamsheer, Central Fisheries, Barrackpore.
 Amma, (Sri) K. Pankajakshi, Research Scholar, Division of Applied Chemistry,
 Central Research Institute, Trivandrum.
 Anantra, Osmania University.
 Ansari, Nasim, Medical College, Calcutta.
 Asthana, Bijoy Kumar, 46/1A, Chakraveria Road, (North), Calcutta.
 Ashthane, (Miss) Usha, 14/1A, Chakravariva Road, (North), Calcutta.
 Asthaner, N. C., 65, Biren Roy Road East, Barisha, Calcutta 8.
 Ayyangar, B. T. R., Applied Chemistry,
 Ayyar, S. A., Rama, Jadavpur College Hostel, Jadavpur.

B

- Bagchi, R.N., C/o. Sm. Anjali Mukherjee, 166, Bowbazar Street, (Basumati)
 Calcutta 12.
 Baksi, Sibhendu Kumar, Geology Dept., Presidency College, Calcutta.
 Balasubramanian, S.C., The Food Technology Laboratory, Indian Institute of
 Science, Bangalore. 8
 Batta Ray, Santa, 17, Rash Behary Avenue, Calcutta.
 Bala, Prafulla K., 24/3A, Mirzapur Street, Calcutta 9.
 Barbara, Manick Ch., 23/2A, Mirzapur Street, Calcutta 9.
 Barua, Madhuri, Botany Dept., Presidency College, Calcutta.
 Barua, Uanjit Kr., Dept. of Physics, Cotton College, Assam.
 Barua, Madhuri, Botany Dept., Presidency College, Calcutta.
 Barua, Haladhar, Surendranath College,
 Baid, Bridhi Chand, City College, Cal.
 Banerjee, Krishnadas, P. O. & Vill. Jagacha, Dist. Howrah.
 Banerjee, Ashoke Kumar,
 Banerjee, Himadri, St. Xavier's College, Calcutta.
 Banerjee, Sukhendu Bikas,
 Banerjee, Jaydeb, St. Xavier's College, Calcutta.
 Banerjee, Sasanka Tilak, 27/1, Dehi Serampur Road, Calcutta 14.
 Banerjee, Keshab Ch., Lake Medical College.
 Banerjee, Amiya, Bethun College, Calcutta.
 Banerjee, Satyendra Nath,
 Banerjee, Niranjan,

- Banerjee, R., C/o. M/s. Murarka Paint & Varnish Works Ltd.,
 Banerjee, Mihir, Science College, Calcutta.
 Banerjee, Haridas, Presidency College, Cal.
 Banerjee, Rabindranath, Surendranath College, Calcutta.
 Banerjee, Anita, Presidency College, Cal.
 Banerjee, Rekha, 15B, Hazra Road, Calcutta 26.
 Banerjee, Manjusree, Presidency College, Cal.
 Banerjee, Samir Kumar, Jadavpore Engineering College, Jadavpore.
 Banerjee, Debabrata, Presidency College, Cal.
 Banerjee, Debabrata, Presidency College, Cal.
 Banerjee, Shyamadas, Presidency College, Cal.
 Banerjee, Rathin, Presidency College, Calcutta.
 Banerjee, Aloke Kumar, P51, B. K. Pal Avenue, Calcutta 5.
 Banerjee, Amalendu, Student of Chemistry, College of Engineering and Technology,
 P156, Lake View Road, Calcutta 29.
 Banerjee, Aniketana, Dept. of Psychology, University College of Science, 92, Upper
 Circular Road, Calcutta 9.
 Banerjee, Ajit Kumar, Geology Dept., Presidency College, Calcutta.
 Banerjee, Asoke Kumar, C/o. Sri Tarasankar Banerjee, P/171, C.C.O.S., Cossipur,
 Calcutta 2.
 Banerjee, Banadev, 9, Grove Lane, Kalighat, Calcutta 26.
 Banerjee, Debabrata, M.Sc., Dept. of Pure Chemistry, University College of Science,
 92, Upper Circular Road, Calcutta 9.
 Banerjee, Gourang Chandra, Zoological Laboratory, University College of Science,
 35, Ballygunge Circular Road, Calcutta 19.
 Banerjee, Hiralal, Canning Hostel, 35, Scott Lane, Calcutta 9.
 Banerjee, M., Dept. of Civil Engineering, B. E. College, Howrah.
 Banerji, Ranajoy, St. Paul's Cathedral Mission College,
 Banerji, Maya, Presidency College, Calcutta.
 Banerji, Mohini, Dept. of Psychology, University College of Science, 92, Upper Cir-
 cular Road, Calcutta 9.
 Banerjee, Narayan Chandra, 9, Daspara Road, Calcutta 4.
 Banerjee, (Sm.) Nilima, C/o. Principal, Basic (Primary) Training College, Banipur,
 24-Parganas.
 Banerji, Pranab Kumar, P-246, Lake Road, Calcutta 29.
 Banerjee, S., Dept. of Civil Engineering, B. E. College, Howrah.
 Banerjee, Samir, Geology Dept., Presidency College, Calcutta.
 Banerjee, Satyaprabhat, C/o. Sm. Anjali Mukherjee, 166, Bowbazar St., Calcutta 12.
 Bandopdhyay, Durgadas, Presidency College, Calcutta.
 Banik, Upendra Kumar, Zoological Laboratory, University College of Science, 35,
 Ballygunge Circular Road, Calcutta 19.
 Barua, (Miss) Aparna, Cotton College, Uzanbazer, Gauhati.
 Barua, Debabrata, University of Calcutta, Dept. of Education, 95, Russa Road,
 Calcutta 26.
 Baruah, Jogendranath, 1A, Swarnamayee Road, Calcutta 9.
 Basu, A., Dept. of Civil Engineering, B. E. College, Howrah.
 Basak, Ranjit Kumar, 15B, Chidam Mudy Lane, Calcutta 6.
 Basu, A. M., 68-4, Lakshman Das Lane, Howrah.
 Basu, Amber Kumar, Dept. of Psychology, University College of Science, 92, Upper
 Circular Road, Calcutta 9.
 Basu, Amitava, 39, Narkeldanga Main Road, Calcutta 11.
 Basu, (Miss) Archana, 68-4, Lakshman Das Lane, Howrah.
 Basu, Asit Ranjan, Eden Hindu Hostel, Calcutta 12.

- Basu, Dipendra Nath, Dept. of Geology, Presidency College, Calcutta 12.
Basu, Durgadas, 8B, Hazra Road, Calcutta 26.
Basu, (Sm.) Manjula, 25, Mohendra Bose Lane, Calcutta 4.
Basu, (Miss) Nilima, 10, Ashu Biswas Road, Calcutta 25.
Basu, Prahlad Kumar, 10, Ashu Biswas' Road, Calcutta 25.
Basu, Tapas Kumar, Dept. of Geology, Presidency College, Calcutta.
Basu, Utpal Kanti, 82, Bazar Road, Behla, Calcutta 34.
Basu Roy Choudhury, Rathindra Chandra, 97-2, Tollygunge Road, Calcutta 26.
Basu Choudhuri, Ashok, K., Prosadpur House, Agra.
Basu, Susanta K., 10, Pratapaditya Road, Calcutta 26.
Basu, Kalyan Kumar, 3rd Year, Science, Vidyasagar College, Calcutta.
Basu, Bela, Scottish Church College,
Basu, Nandita, City College, Calcutta.
Basu, Ajay K.,
Basu, (Sm.) Pramitu,
Basu, Amarendranath, Basic Training College.
Basu, Santimay, (R. P.)
Basu, Prasanta, 14, Sardar Sarkar Road, Calcutta 26.
Basu, Nirmalendu, 6, Lower Range, Calcutta 17.
Basu, Phani Gopal, 61, Linton Street, Calcutta.
Basu, Sreelekha, 2/2, Southern Avenue, Calcutta 26.
Basu, Sunandan Narayan, Presidency College, Calcutta.
Basu, Jayanta, Cotton College, Assam.
Basu, Dillip Kr., Presidency College, Calcutta.
Basu, Kamal K., Presidency College, Cal.
Banik, Bani, Presidency College, Calcutta.
Banik, Nandadulal Datta,
Basak, Subodh Ch.,
Basak, Prasanta Kumar, 15, Anukul Mukherjee Road, Calcutta 6.
Barik, Panchkari, 209, Cornwallis Street, Calcutta.
Bagchi, Samir, N. P. S. Medical College, Calcutta.
Bagchi, Manotosh, N. R. S. Medical College,
Bagchi, Anil Chandra, Applied Physics, Science College,
Bagchi, Asru, Science College,
Bagchi, Asru Kumar, Science College, Calcutta.
Bagchi, Sakti P., Science College, Cal.
Barman, Amalendu Ray, Presidency College, Calcutta.
Barman, Ranjit Kumar, 6th Year, Applied Math., Roll. 11.
Barman, Mahendra Nath, Dept. of Physics, Cotton College, Assam.
Barthakar, Mina Dhar, Gauhati University,
Bagchi Subhendu Gopal, Calcutta University, Calcutta.
Balasubramaniam, K., St. Paul's College, Cal.
Batabyal, Nishit K., Presidency College, Cal.
Batabyal, Nishie K., Presidency College, Cal.
Barman, Sadhan Jyoti, Presidency College, Cal.
Bera, Arati, 4th Year, B. A., Ashutosh College, Calcutta.
Bera, Nripendra K., Ashutosh College, Calcutta.
Berah, Lakshi Nanda, Dept. of Physics, Cotton College, Assam.
Benjam. Bachhraj, City College, Calcutta.
Benerjee, Biswanath, Presidency College, Cal.
Bhattacharjee, Bibhuti Bhusan,
Bhattacharji, Pannalal, 21-B, Jellapara Lane, Calcutta.
Bhattacharjee, Supriya K., City College, Calcutta.

- Bhattacharjee, 43-2B, Bagbazar Street, Calcutta.
 Bhattacharyya, Bimal Kanti, 29A, Raja Dinendra Street, Calcutta.
 Bhattacharjee, Dilip Kumar, 3, Bhowani Dutt Lane, Calcutta.
 Bhattacharjee, Bibha, Botany Dept., Pres College, Calcutta.
 Bhattacharjee, Amitabha, Burabazar, Chandernagore.
 Bhattacharjee, Tarapada, 31/A, Tengra Road, Calcutta 15.
 Bhattacharjee, Bangabashi College, Calcutta.
 Bhattacharjee, M. L., Indian Statistical Institute, Calcutta.
 Bhattacharjee, Mantu, C/o. A. N. Maitra, R. G. Kar Medical College, Calcutta.
 Bhattacharjee, Gauhati University.
 Bhattacharjee, Geeta, Scottish Church College,
 Bhattacharjee, Dilip,
 Bhattacharjee, Arun.
 Bhattacharjee, Debarata,
 Bhattacharjee, Tarapada, Presidency College, Calcutta.
 Bhattacharjee, Sibram, 95, Russa Road, Calcutta 26.
 Bhattacharjee, Sauripada, Presidency College, Calcutta.
 Bhattacharjee, Bidhubhusan, Bangabashi College, Calcutta.
 Bhattacharjee, Minati, Presidency College, Calcutta.
 Bhattacharjee, Phanindra, 9, Muralidhar Sen Lane, Calcutta.
 Bhattacharjee, Biren, Science College, Cal.
 Bhattacharjee, Kamaleswar, Presidency College, Cal.
 Bhattacharjee, Amar, Medical College,
 Bhattacharjee, Mathuresh, Presidency College, Cal.
 Bhattacharjee, Mathuresh, Presidency College, Cal.
 Bhattacharjee, Prosad K, Presidency College, Cal.
 Bhattacharji, Ashutosh, Medical College, Calcutta.
 Phanja, N. K., Dept. of Civil Engineering, B. E. College, Howrah.
 Bhargava, P. N., U. P. Govt. Research Workers, Chemistry Dept., Benaras Hindu University, Banaras.
 Khatia, (Miss) Bimala, Dept. of Zoology, University of Delhi, Delhi.
 Bhattacharya, A. Dept. of Civil Engineering, B. E. College, Howrah.
 Bhattacharya, Ashoke, C/o. Tarapada Bhattacharya Esqr., Asst. Master, Barasat Govt. H. E. School, Barasat, 24-Parganas.
 Bhattacharyya, Arun Kumar, Eden Hindu Hostel, Calcutta 12.
 Bhattacharyya, Baidvanath, Dept. of Education, University of Calcutta, 95, Russa Road, Calcutta 26.
 Bhattacharyya, Bhulanga, University of Calcutta, Dept. of Education, 95, Russa Road, Calcutta 26.
 Bhattacharya, Binoyendra, 76-2, Cornwallis Street, Suit No. X-10, Calcutta 6.
 Bhattacharjee, Narayan Chandra, C/o. Dr. Shibdas Bhattacharjee, Rajpore, VIII. Sonarpur, Dt. 24-Parganas.
 Bhattacharjee, Nripendra Kumar, 120, Tarak Pramanik Road, Calcutta 6.
 Bhattacharya, (Sm.) Rama, 35, Scotts Lane, Calcutta 9.
 Bhattacharva, R. K., C/o. Sm. Anjali Mukherjee, 166, Bowbazar Street (Basumati), Calcutta 12.
 Bhattacharjee, Ranendra Kumar, 158A, Bakul Bagan Road, Calcutta 25.
 Bhattacharyya, Tarak Prosad, 7-1, Hidaram Banerjee Lane, Calcutta 12.
 Bhattacharya, Shyamalendu, 372-67, Russa Road, South, Calcutta 33.
 Bhattacharyya, Somnath, Dept. of Psychology, University of Calcutta, 92, Upper Circular Road, Calcutta 9.
 Bhattacharyya (Dr.) S. C., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.

- Bhattacharyya, (Sm.) Ila, 20-9A, Iswar Ganguly Street, Calcutta 26.
 Bhattacharyya, Narayan Das, 99-1B, Cornwallis Street, Cal.
 Bhattacharyya, Jatish Ch.,
 Bhattacharyya, R. N., Gauhati University,
 Bhattacharyya, Bimalendu, Science College,
 Bhattacharyya, Sambhunath, 24A, Giris Bidyaratna Lane, Calcutta.
 Bhattacharyya, Golokendra, Botany Dept., Presidency College, Calcutta.
 Bhattacharyya, Santi, 3, Bhawani Dutt Lane, Calcutta.
 Bhattacharya, Baruna, Presidency College, Calcutta.
 Bhattacharya, Sunil, Presidency College, Calcutta.
 Bhattacharya, Durga Prosanna, Botany Dept., Presidency College Calcutta.
 Bhattacharya, Payodhi, Presidency College, Calcutta.
 Bharnali, P., C/o. M. C. Bhuiyan, Hardinge Hostel, Calcutta 7.
 Bhaduri, Debdas, Presidency College, Calcutta.
 Bhawmik, K.,
 Bhaumik, Sreepati Ch., 95, Russa Road, Calcutta 26.
 Bhaumik, Paresdhar., (R. P.)
 Bhatnagar, Satyaprakash,
 Bhaduri, Tripti, Presidency College, Cal.
 Bhaduri, Sanat Kumar, Presidency College, Cal.
 Bharadwaj, Master, 3, Harrington Street, Calcutta.
 Bhandari, S. R., Bangabasi College, Calcutta.
 Bharati, T., Dept. of Physics, Cotton College, Assam,
 Bhuyan, Mahes Ch., Hardinge Hostel,
 Bhuyan, J., C/o. Sri M. C. Bhuiyan, Hardinge Hostel, Calcutta 7.
 Bhowmik, Nirmalendu, 24, K. L. Goswami Street, Cerampore.
 Bhuyan, Bijoy Kr., Vidyasagar College, Calcutta.
 Bhowmick, Ananda Mohan, 12, Krishna Mullick Road,
 Bhowmik, Balaram, Sanskrit College,
 Bhowal, Judugopal, Presidency College, Cal.
 Bhaduri, Bhaskar Nath, 13, Elgin Road, Calcutta 20.
 Bhaduri, (Sm.) Lalita, 43-G, Ultadingi Road, Calcutta.
 Bhadra, Dilip Kumar, 19, Eden Hospital Road (2nd Floor), Calcutta 12.
 Bhandari, Krishan Gopal, Dept. of Zoology, University of Delhi, Delhi 8.
 Bhandari, P. K., M.Sc., Dept. of Applied Chemistry, Indian Institute of Science,
 Bangalore 3.
 Bhose, (Sm.) Amita, 24A, Ray Bagan Street, Calcutta 6.
 Bhuvaneswari, (Miss) K., B.Sc., Post Graduate Student in Botany, Annamalai University, Annamalainagar.
 Biswas, Shyamal Kanti, Presidency College, Calcutta.
 Biswas, Dines Ch.,
 Biswas, Sudhansu, 4/1E, Wellington Street, Calcutta 12.
 Biswas, Mihir, Indian Institute of Technology, Kharagpur, B. N. Rly.
 Biswas, Pronab, 11, Durgapur Lane, Calcutta 27
 Biswas, Gopal Ch., 27/1, Dehi Serampur Road, Calcutta 14.
 Biswas, Sunilranjan, Eden Hindu Hostel, Calcutta 12.
 Biswas, Subhas Kr., University College of Science, Anthropology Dept.
 Biswas, Ashish Kr., Presidency College,
 Biswas, Basanta Kr., Lake Medical College,
 Biswas, Chapala, City College,
 Biswas, Dipika, St. Paul's College,
 Biswas, Manashi, Science College, Calcutta.
 Biswas, Nripen, 45/1, Amherst Street, Calcutta.

- Biswas, Mukul, 3/8, Gorachand Bose Road, Calcutta.
- Biswas, Paresh K., Presidency College, Cal.
- Biswas, Paresh K., Presidency College, Cal.
- Biswas, Debajit Kumar, Presidency College, Cal.
- Biswas, Subrata Sinha, Presidency College, Cal.
- Biswas, Basudev, Presidency College, Cal.
- Biswas, S.G., 51, Hazra Road, Calcutta.
- Biswas, Balai, Motijhil, Dum Dum.
- Bishnu, Nirmalendu, Presidency College, Calcutta.
- Bishayee, Amiya Kanti, Eden Hindu Hostel, 3, Peary Sarkar Street. Room No. 53, Calcutta 12.
- Biswas, Kumar Ananda, Eden Hindu Hostel, Calcutta 12.
- Biswas, Ardhendu, 9, Bright Street, Calcutta 19.
- Biswas, Dwijendranath, 8, Panchanan Ghosh Lane, Calcutta 9.
- Biswas, Kartik Chandra, 7B, Valmeek Street, Calcutta 26.
- Biswas, Sanjit, Geological Laboratory, Presidency College, Calcutta.
- Biswas, Subodh Ranjan, C/o. Sri Narayan Chandra Dey, Ramkrishna Mission Students Home, 20, Harinath De Road, Calcutta 9.
- Brambachary, Rabin, N. R. Sarkar Medical Hostel, 73, Dharamtolla Street, Calcutta.
- Pose, Asit Kumar, 29, Huzuri Mull Lane, Calcutta 14.
- Bose, Bejoy Krishna, Eden Hindu Hostel, 3, Peary Sircar Street, Calcutta 12.
- Bose, Deb Kumar, 8A, Priyanath Banerjee Lane, Calcutta 9.
- Rose, Himangshu Bhusan, 122-C, Rash Behari Avenue, Calcutta 29.
- Pose, Hemendra Chandra, Dept. of Education, University of Calcutta, 95, Russa Road, Calcutta 26.
- Bose, (Miss) Hiranya Prova, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Pose, Mihir, Geological Laboratory, Presidency College, Calcutta.
- Pose, Pranab, C/o. Anjali Mukherjee, 166, Bowbazar Street, Calcutta 12.
- Pose, P. C., Research Student, Dept. of Chemistry, Lucknow University, Lucknow.
- Bose, Rabin, Geological Laboratory, Presidency College, Calcutta.
- Pose, Rabindranath, Geology Dept., Presidency College, Calcutta.
- Bose, Rathin, Canning Hostel, 35, Scott Lane, Calcutta 9.
- Bose, (Miss) Reba, B. Sc., University College of Science, Dept. of Psychology, 92, Upper Circular Road, Calcutta.
- Bose, (Miss) Sadhana, B.A., B.T., Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Bose, (Sm.) Seba, Dept. of Education, University of Calcutta, 95, Russa Road, Calcutta 26.
- Bose, Sukumar, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Blanchard, E. S., Science College, Calcutta.
- Bora, Rajan, R. G. Kar Medical College, Calcutta.
- Bore, Lalmohon.
- Bose, Nimal Ch., Calcutta National Medical Institute, Calcutta.
- Bose, Ranjit Kumar, R. G. Kar Medical College, Calcutta.
- Bose, Prasanta Kumar, R. G. Kar Medical College, Calcutta.
- Bose, Debarata, 15, Kantapukur Lane,
- Bose, Suwendu,
- Bose, Chiranjit, 5th Year, Bengalt, C. U., Calcutta.
- Bose, Sukhendra Krishna, City College, Calcutta.
- Bose, Avannil, 2/1, Pittambar Bhattacharyya Lane, Calcutta 9
- Bose, B.,

- Bose, Hemanta Kr., 3/1, Nabin Senapati Lane, Kasmdia House,
 Bose, Niranjan,
 Bose, Sudha,
 Bose, (Miss) Amiya,
 Bora, Bhuban, Dept. of Physics, Cotton College, Assam.
 Bose, Prity, Science College, Calcutta.
 Bose, Jayanta K., Presidency College, Calcutta.
 Bose, Briplab K., Ashutosh College, Calcutta.
 Bose, Sukesh, C/o. M/s. Murar Ka Paint & Varnish Works Ltd.,
 Bose, Timir K., Calcutta National Medical College, Calcutta.
 Bose, Kanak, Presidency College, Calcutta.
 Bose, Ramen, Science College, Cal.
 Bose, Arun Chandra, Scottish Church College, Cal.
 Bose, Smitimoy, P. G. Class, Calcutta University.
 Bornali, Dimbeswar, Dept. of Physics, Cotton College, Assam.
 Bosu, P. K., Medical College.
 Borua, Girish Sarma, Cotton College, Assam.
 Burman, Bikram Keshari Roy, Department of Anthropology, University of Calcutta,
 Burman, Amalendu Roy, Geology Dept., Presidency College, Calcutta.

C

- Chakraborty, Amiya Kumar, B.Sc., Dept. of Pure Chemistry, University College of
 Science, 92, Upper Circular Road, Calcutta 9.
 Chakraborty, Arunangsu, Geology Dept., Presidency College, Calcutta.
 Chakravarty, Bhola Nath, 90, Talpukur Road, Belehghata, Calcutta .
 Chakraborty, Debidas, Ramkrishna Mission Students Home, 20, Harinath Dey Road,
 Calcutta 9.
 Chakraborty, Debabrata, C/o. Prof. N. P. Chakravorty, Jadavpur Coloney, Cal. 32.
 Chakravarty, Jiban Kumar, Research Student, Chemical Laboratory, Presidency
 College, Calcutta.
 Chakravarti, Jyoti Kanta, C. E. T. Hostel, Room No. A84, Jadavpur College P.O.,
 Calcutta 32.
 Chakravorty, Kanailal, Geology Laboratory, Presidency College, Calcutta.
 Chakravarty, Kartick Chandra, 29, Lansdown Place, Calcutta 29.
 Chakravarty (Sm.) Maduri, Dept. of Psychology, University College of Science, 92,
 Upper Circular Road, Calcutta.
 Chakraborty, Sachindra Mohan, Zoological Laboratory, University College of
 Science, 35, Ballygunge Circular Road, Calcutta 19.
 Chakravorty, Samir, N. R. Sarkar Medical College Hostel, 73, Dharamtollah Street,
 Calcutta.
 Chakraborty, Shiba Prasad, Student, Chemical Engineering College, 28-1, Convent
 Road, Flat No. 2, Calcutta 14.
 Chakravorty, Debiprosad, Presidency College, Calcutta 1.
 Chakravarty, Scottish Church College, Calcutta.
 Chakravarty, Madhusudan,
 Chakravarty, Sujit,
 Chaudhury, Subrata,
 Charkravarty, Parikrhit,
 Chakravarty, Alok, Presidency College, Calcutta.
 Chakravarty, K., 12, Gardiner Road, Lilooah.

- Chakravarty, Sukhamay, Presidency College, Calcutta.
 Chakravarty, Prankumar, Presidency College, Calcutta.
 Chakravarty, Sambhunath, 12B, Kunjanath Banerji Street, Calcutta.
 Chakravarty, Ajoy, Medical College, Cal.
 Chakravarty, Biswa Ranjan, Science College, Cal.
 Chakravarty, Govindalal, Calcutta Medical College, Cal.
 Chakravarty, Ardhendu, Presidency College, Calcutta.
 Chakravarty, Satya, Presidency College, Cal.
 Chakravarty, Satya, Presidency College, Cal.
 Chakravarty, Deb Kumar, 35A, Shyamananda Road, Calcutta 25.
 Chakravarty, Sankar Lal, Botany Dept., Presidency College, Calcutta.
 Chakravarti, Amalendu Sekhar,
 Chakravarti, Monoj. R., University College of Science, Calcutta.
 Chakravarti, Sukhomoy, Science College, Calcutta.
 Chakravarti, Scottish Church College, Calcutta.
 Chakravarti, Gouri, 11, Prince Baktiar Shah Road, Calcutta 33.
 Chakravarti, Binoy K., Presidency College,
 Chakravarti, Sailendra Krishan,
 Chakravarti, (Miss.) Niva.
 Chakravarti, B. N.,
 Chakravarti, Dinesh Chandra, 19/1B, Creek Row, Calcutta.
 Chakravarti, O. M., 14B, Palmer Bazar Road, Calcutta 15.
 Chakravarti, Ramaprosad, Surendranath College, Calcutta.
 Chakravarti, Priya Sankar, 18, Jadulal Road, Calcutta 6.
 Chakravarti, Nirmal Baran, 16, Jagadish N. Roy Lane, Calcutta 6.
 Chaliha, (Miss) Rekha, P-21, Golf Club Road, Calcutta 33.
 Chandra, Prosad, Geology Laboratory, Presidency College, Calcutta.
 Chandratreya, P. V., Research Student, Spectroscopic Laboratory, Institute of Science, Bombay 1.
 Chatterjee, Amiya Kumar, 35, Kasundia Road, Howrah.
 Chatterjee, Asoke, Geology Laboratory, Presidency College, Calcutta.
 Chatterjee (Mrs.) Bibha Rani, 22, Satkari Mitra Lane, Calcutta 11.
 Chatterjee, Bidyut Kumar, 112, Amherst Street, Calcutta 9.
 Chatterjee, Kali Sahaya, 3, Swarnalata Street, Calcutta.
 Chatterjee, Kamal, 9, Bright Street, Calcutta 19.
 Chatterjee, R., Dept. of Civil Engineering, B. E. College, Howrah.
 Chatterjee, R. K., Chemistry Division, Indian Agriculture Research Institute, New Delhi.
 Chatterjee, Krishnapada, City College, Cal.
 Chatterjee, Bidhan Chandra, City College, Cal.
 Chatterjee, Bireswar, City College, Calcutta.
 Chatterjee, City College, Calcutta.
 Chatterjee, Anadi N., Presidency College, Calcutta.
 Chatterjee, Ashish, St. Paul's College,
 Chatterjee, Mridula, Bethune College, Calcutta.
 Chatterjee, Amareswar, 2, Lowdon Street, Calcutta 16.
 Chatterjee, Imajit,
 Chatterjee, S., Law College, Calcutta.
 Chatterjee, Bimal, 3, Peary Sarkar Street, Calcutta 6.
 Chatterjee, Harishikesh, Botany Dept., Presidency College, Calcutta.
 Chatterjee, Saral, C/o. The Prefect, St. Xavier's College, Calcutta.
 Chatterjee, Sasanka Sekhar, Botany Dept., Calcutta University, Calcutta.
 Chatterjee, Juthika, 92A, Lansdown Road, Calcutta 26.

- Chatterjee, Santosh K.,
Chatterjee, Lakshini Kanta, Eden Hindu Hostel, Calcutta 12.
Chatterjee, Satya Ranjan,
Chatterjee, Salil K., Botany Dept., Presidency College, Cal.
Chatterjee, Jyotirmoy, 65F, Jalunddi Mistri Lane, Calcutta 27
Chatterjee, Bhalrab, Presidency College, Cal.
Chatterjee, Bhalrab, Presidency College, Cal.
Chatterjee, Hrishikesh, Presidency College, Cal.
Chatterjee, R. N., Civil Engineering, B. E. College, Howrah.
Chatterjee, Sudhansu, Medical Hostel, 29, Beniapukur Road, Entally, Calcutta.
Chatterjee, Suprakash, 32B, Anath Nath Deb Lane, Calcutta 37.
Chatterjee, Tarapada, Zoological Laboratory, University College of Science, 35,
Ballygunge Circular Road, Calcutta 19.
Chattopadhyay, Basudeb, Eden Hindu Hostel, Calcutta 12.
Chattopadhyay, D. K., Dept. of Physiology, Presidency College, Calcutta.
Chattopadhyay, Ram Chandra, Bangabashi College,
Chattopadhyay, Gauranga, 2, Palm Place, Calcutta 19.
Chattopadhyay, (Sm.) Gayatri, 66, Vivekananda Road, Post Graduate University
Hostel, Calcutta 6.
Chaudhuri, Sitaram, City College, Calcutta,
Chaudhuri, Chiranjit Lal, City College, Calcutta.
Choudhuri, Tapash K., Presidency College, Cal.
Choudhuri, Kedareswar, Botany Dept., Presidency College, Calcutta.
Chaudhuri, Jagadindra N.,
Chaudhuri, Amalendu Hore 69/A, Theatre Road, Calcutta 17.
Chowdhuri, Milan K., 114A, Ashutosh Mukherjee Road, Calcutta 25.
Chaudhuri, P. C., Law College, Calcutta.
Choudhuri, Sarat Chandra, Ray, Geological Laboratory, Presidency College, Calcutta.
Choudhuri, Sasabindu, 19A, Mohan Lal Street, Calcutta 4.
Choudhuri, Kedareswar, Botany Dept., Presidency College, Calcutta.
Chaudhuri, Arndendu Shekhar, Surendranath College, Calcutta.
Chaudhuri, P. M. Saha, Physiology Dept.,
Chaudhuri, Arabinda, City College, Calcutta.
Chowdhuri, Subimal, Presidency College, Calcutta.
Chaudhuri, Asoke, Medical College, Cal.
Choudhuri, Bimalkanti, Presidency College, Cal.
Chaudhuri, Manas Kumar, 4-43, Vivek Nagar, Calcutta 32.
Chaudhuri, Narayan Prasad, R. G. Kar Medical College, Calcutta.
Chauhan, V. B. Singh, Research Student, Chemistry Dept., University of Lucknow,
Lucknow.
Coondoo, Sunil Kumar, Annapurna Thakurbari, Barisha, Calcutta 8.
Chowdhury, D. K., Dept. of Civil Engineering, B. E. College, Howrah.
Chowdhury, Kalyan, C/o. Sri K. N. Chowdhury, 45B, Parasar Road, Calcutta.
Choudhury, (Miss) Animo, Student of P. G. Chemistry Dept., University College of
Science, 27-1, Chowdhury Lane, Calcutta 4.
Choudhury, Amallesh, University College of Science, Zoological Laboratory, 35, Bal-
lygunge Circular Road, Calcutta 19.
Choudhury, (Sm.) Anima, C/o. Principal, Basic (Primary) Training College, Banipur,
24-Parganas.
Choudhury, (Sm.) Nandita, 4-11, Fern Road, Ballygunge, Calcutta 19.
Chowdhury, Mihir, 4, Pitambar Bhattacharya Lane, Calcutta 9.
Choudhury, Punya Brata, 35B, Lake Place, Calcutta 29.
Choudhury, Pranab Kumar, 23, Baje Shibpore Road, Shibpore, Howrah.

- Choudhury, (Miss) Purnima, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Chaudhury, (Miss) Maya, 9-3, Krishna Mallick Lane, Calcutta.
- Chowdhury, Anubha,
- Chaudhury, Bhupendra,
- Chaudhury, Sunit Kumar,
- Choudhury, R. 14B, Gorachand Road, Calcutta 14.
- Chaudhury, Amal Chandra, 35, Ballygunge Circular Road, Calcutta.
- Chaudhury, Bimal Kumar Dhar,
- Chaudhury, Renuka, City College.
- Chaudhury, Indira, 61C, Lansdown Road, Calcutta.
- Chowdhury, Debi Prasad Basu,
- Chaudhury, N., 45-1A, Amberst Street, Calcutta 9.
- Choudhury, Nirendra Ch.,
- Chowdhury, Jyotsnamoy, Presidency College, Cal.
- Chowdhury, Gita, N. S. Med. College,
- Chowdhury, Uma, C/o. Dr. Sarma,
- Chaudhury, Jatindranath, Calcutta National Medical Institute, Cal.
- Chaugkakoti, Sumati, Dept. of Physics, Cotton College, Assam.
- Chandra, Cita, City College.
- Chandra, Sanatan, 70, Syed Amir Ali Avenue,
- Chamba, Navandra Singha, Science College, Calcutta.
- Chalika, Baniprasad,
- Chand, Ramesh Chandra,
- Chaklia, Phani Bh., Presidency College Calcutta.
- Chaki, Anil Behari, Central Inland Fisheries, Barrackpore.
- Chhajir, Chandanmal, City College, Cal.
- Chibber, R. K., Chemistry Division, Indian Agriculture Research Institute, New Delhi.
- Chibber, V. N., Research Student, Dept. of Geology, Benaras Hindu University, Benaras.
- Chandak, Purak Chand, City College, Cal.
- Cherayath, M., R. G. Kar Medical College, Calcutta.

D

- Datta Gupta, R. R., Radio Ph.
- Datta, Ray, R. L.,
- Datta, K. C.,
- Datta, Satyabrata, Radio Physics.
- Datta Ray, Santosh,
- Datta, Buddhadev, Ashutosh College, Calcutta.
- Data, K. N., All India Institute of Hygiene & Public Health.
- Datta, (Sm.) Chinmayee, C/o. Anjali Mukherjee, 166, Bow Bazar Street, Calcutta 12.
- Datta, Manoranjan, T-8-4, Northland, Ichapur, 24-Parganas.
- Datta, (Miss) Madhuri, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
- Datta Chowdhury, Sukumar, 9, Bright Street, Calcutta 19.
- Dutta Majumdar, Sitangsu, Dept. of Education, 95, Russa Road, Calcutta 26.
- Datta Ray, Sachchidananda, 7F, Dev Lane, Calcutta 7.
- Datar, (Dr.) M. G.
- Das Gupta, Amritava, 26/1B, Bright Street,

- Das Gupta, Subrata, Presidency College, Cal.
 Das Gupta, Arun K., Presidency College, Calcutta.
 Das Gupta, Bidhan Ranjan, Presidency College, Calcutta.
 Das Gupta, Hari Sankar, Presidency College, Cal.
 Dasgupta, Tripty, Presidency College, Calcutta.
 Dasgupta, Naresh, 31B, Sakharitola Street, Calcutta.
 Das Gupta, Phani Bhusan, 2, Ballav Street, Calcutta.
 Das Gupta, Asoke Kumar,
 Das Gupta, Kalyan Kumar,
 Das Gupta, Sandhya,
 Das Gupta, Lokesh R., 9, Bright Street,
 Das Gupta, Sushil, Vidyasagar College, Calcutta.
 Das Gupta, Subrata, Presidency College, Cal.
 Das, Kalidas,
 Das Anadi Jiban, 8B, Brindaban Pal Bye Lane, Calcutta 1.
 Das, Purna Rekha, S. P.'s Bunglow, Howrah.
 Das, Nisweswar, 21B, Mohonlal Street, Calcutta 4,
 Das Chaudhuri, Purnachandra, Bangabasi College,
 Das, Debabrata,
 Das, S. N.,
 Das, Dhaneswar, Science College, Calcutta.
 Das, Kamalendu,
 Das, Anil Kr., 71, Mirjapur St., Calcutta.
 Das, Nihar Ranjan, Presidency College,
 Das, Arun Kumar, Vidyasagar College, Calcutta.
 Das, Sushil Kumar,
 Das, Parimal, Bengal Veterinery College,
 Das, Bibhuti Bhusan, Presidency College, Cal.
 Das, Kalipada, Presidency College,
 Das, Bholanath, Presidency College, Calcutta.
 Das, K. Hirendra, Presidency College, Calcutta.
 Das, Mina, Science College,
 Das, Prafulla Ranjan, 17A, Fordes Lane, Calcutta 14.
 Das, Sisir K., Bangabasi College,
 Das, Soumendra Kumar, Science College, Cal.
 Das, A. S. C., Central Fisheries, Barrackpur.
 Das, Raugalal, Medical College,
 Das, Tushar Kanti, R. G. Kar Medical College, Calcutta.
 Das, Biman, R. G. Kar Medical College, Calcutta.
 Das, Robindra N., 52, Baldiagara Road Calcutta 6.
 Das, Narayanarayan, Eden Hindu Hostel, Calcutta.
 Das, Amal Kanti, Nilratan Sarkar Medical College, Calcutta.
 Das, Jogesh, R. G. Kar Medical College Calcutta.
 Das, Ajoy Kumar, Bangabasi College, Calcutta.
 Das, Harirani, Scottish Church College, Calcutta.
 Das, Sailen Kr., Science College, Calcutta.
 Das, Kanak Chandra, Dept. of Physics, Cotton College, Assam.
 Das, Jyoti Ranjan
 Das, Sadananda,
 Das Roy, Krishna, 11, Ratan Babu Road, Calcutta.
 Das, Paresh Chandra, 61-1E, Wellington Street, Calcutta 9.
 Daka, Bhupati, Cotton College Assam
 Dalabar, Panchugopal, City College, Calcutta.

- Das, Ajay Kumar, 7B, Valmeek Street, Calcutta 26.
- Das, B., Dept. of Civil Engineering, B. E. College, Shibpur, Howrah.
- Das, Bhushan Chandra, C/o. Anil Kumar Chatterjee, 3-3, Nanda Ram Sen Street, Calcutta.
- Das, Biresch Chandra, Canning Hostel, 35, Scot Lane, Calcutta 9.
- Das, Bhuban Mohan, P. G. Science Mess, 35, Ballygunge Circular Road, Calcutta 19.
- Das, Debajyoti, 205, Cornwallis Street, Calcutta 6.
- Das, Dhiraj Mohan, Presidency Post Graduate Hostel, 1-A, Rani Sarnamani Road, Calcutta.
- Das, Jyotirmoy, 13A, Fakir Chand Mitra Street, Calcutta 9.
- Das, Kalyan Kumar, 7B, Valmeek Road, Calcutta 26.
- Das, Mati Lal, A. G. Chandra Chhatrabas, Room 28, 35, Scott Lane, Calcutta 9.
- Das, Madan Mohan, 111, Mollapara Lane, Shibpur, Howrah.
- Das, Rakhanlal, 50-3B, Sri G. M. Lane, P. G. Mess, Calcutta University, Calcutta 12.
- Das, Nareesh Chandra, 25, Abinash Banerjee Lane, Santragachi P.O., Howrah.
- Das, Narendra Kumar, Acharyya Girish Chandra Chhatrabas, 35, Scott Lane, Room No. 33, Calcutta 9.
- Das, P. C., 2, Store Road, Calcutta 19.
- Das, Rajat Kumar, 17-B, Mohini Haldar Street, Calcutta 26.
- Das, (Miss) Sabita, 9, Ramlal Mookherjee Lane, Calcutta.
- Das, (Miss) Santi, Dept. of Psychology, Science College, 92, Upper Circular Road, Calcutta.
- Das, Sukhendu Bikash, Canning Hostel, 35, Scott Lane, Calcutta 9.
- Das, V. Sitaram, University of Delhi, Delhi.
- Dass, Mrinmoyee, 13A, Fakir Chand Mitra Street, Calcutta 9.
- Das Gupta, Asok, 3rd Year Student, Mechanical Eng. Dept., Jadavpur Engineering College, Calcutta 32.
- Das Gupta, (Miss) Bijoya, Dept. of Psychology, Science College, 92, Upper Circular Road, Calcutta.
- Das Gupta, Biswapati, Zoology Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta 19.
- Das Gupta, Dhrubajyoti, Kamarhati P.O., Agarpara, 24-Parganas.
- Das Gupta, Narendra, Dept. of Education, Calcutta University, 95, Russa Road, Calcutta 26.
- Das Gupta, Santosh Kumar, 3-21, R. K. Chatterjee Road, Dhakuria P.O., Calcutta.
- Debajyoti, N. R. S. Medical College,
- Deb, Bimalendu, Presidency College, Calcutta.
- Deb, Malay K., Bangabashi College,
- Deb, (Miss) Bela, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
- Deb, (Sm.) Rekha, 12A, Southern Avenue, Calcutta 26.
- Deb, Susnata, Geological Laboratory, Presidency College, Calcutta 12.
- Deb, S. K., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore.
- Deb Gupta, D., Dept. of Civil Engineering, B. E. College, Howrah.
- Debi, Gita Rani, P244, Lake Road, Calcutta 29.
- Desai, R. L.
- De, Bidyut, Medical College Hostel, 73, Dharamtolla Street, Calcutta.
- De, (Miss) Gita, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
- De, Paritosh, 6, Bhola Nath Kundu Lane, Calcutta 5.
- De, Nihar Ranjan,
- De, Rakhal Ch., Vidyasagar College, Calcutta.
- De, Aswini Kumar, Bangabasi College,
- De, Jyotirmoy, Science College,
- De, Sankar Ch., 20B, Hindaram Banerjee Lane.

- De, Aniruddha, Presidency College, Cal.
 De, Barunlal, Presidency College,
 De, Monoranjan, Bangabashi College, Calcutta.
 De, Tushar, Science College, Calcutta.
 De Majumdar, Dibyendu Mohon, 4th Year, Science, Se. 'C,' Roll 155, Bangabasi College, Calcutta.
 Dey, Ranjit Kumar, 46, Peary Mohan Sur Garden Lane, Calcutta 10.
 Dey, (Miss) Sabita, 35, Parasar Road, Calcutta 29.
 Dey, Ganesh Chandra, C/o. Sri Panch Kari Dey, P.O. Uttarpara, Dist. Hooghly.
 Dey, Narayan Chandra, C/o. Bamkrishna Mission Student's Home, 20, Harinath Dey Road, Calcutta 9.
 Dey, Samarendu K., 2, Bhola Nath Kundu Lane, Calcutta.
 Dey, Ranjit Kumar, 15, Girish Chandra Bose Road, Calcutta 14.
 Dey, (Mrs) Renu,
 Dey, Panchanan, 6 & 7, Khugan Mohan Mukherjee Lane, Howrah.
 Dev, Reba, Presidency College, Cal.
 Dev, Asit K.,
 Dev. (Sm.) Pratima, C/o. Principal, Basi (Primary) Training College, Banipur.
 Dev, (Dr.) Sukh, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore.
 Devi, (Miss) K. Parvati, C/o. Prof. S. S. Joshi Head of the Dept. of Chemistry, Benaras Hindu University, Benaras.
 Devi, (Miss) Vedantam Snjatha, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Deka, Birendra Kr., Dept. of Physics, Cotton College, Assam.
 Dekz, Ram Charan, Cotton College, Gauhati,
 Deshmukh, G. S., C/o. Head of the Dept. of Chemistry, Benaras Hindu University, Benaras.
 Deshpande, C. M., Dept. of Chemistry, University of Poona, Poona 4.
 Deshpandre, S. M., C/o. Prof. S. S. Joshi, Head of the Dept. of Chemistry, Benaras Hindu University, Benaras.
 Deshpande, V. V., The Institute of Science, Mayo Road, Fort, Bombay 1.
 Dhar, Provakar,
 Dhar, (Sm.) Rekha,
 Dhar, Krishen, 45-1A, Amherst Street, Calcutta
 Dhar, Rekha, 39, Mahanirban Road, Calcutta.
 Dhar, Sunil, C/o. The Prefect, St. Xavier's College, Calcutta.
 Dhar, Paramesh Ranjan, C/o. S. S. K. Ghosh, 38-2A, Gariahata Road, Calcutta 19.
 Dhavle, (Mrs) Shalinibal, Indian Statistical Institute, Calcutta.
 Dhara, A. K., Dept. of Civil Engineering, B. E. College, Howrah.
 Dikshit, K., City College, Calcutta.
 Doogar, N. M., R. G. Kar Medical College, Calcutta.
 Dutta, Santosh,
 Dutta, Raj Kumar,
 Dutta, Ghana, Dept. of Physics, Cotton College, Assam.
 Dutta, Saroj, Dept. of Physics, Cotton College, Assam.
 Dutta Jyotirmoy,
 Dutta, Frobbat K., Bangabashi College, Calcutta.
 Dutta, Madan Mohon, Calcutta National Medical Institute, 32, Gora Chand Road, Calcutta.
 Dutta, Mandira,
 Dutta, Susim Mukul, Presidency College, Calcutta.
 Dutta, Sushanta K., Presidency College, Calcutta.
 Dutta, Arunagshu, Presidency College, Cal.

- Dutta, Asoke K., University of Calcutta, Calcutta.
 Dutta, Tapan K., R. G. Kar Medical College, Calcutta.
 Dutta, Narendra Mohan, 8B, Brindabanpal Bye Lane, Calcutta 4.
 Dutta, Mrinalkanti, Presidency College, Calcutta.
 Dutta, Asoke, Geological Laboratory, Presidency College, Calcutta 12.
 Dutta, Kanakendra Nath, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Dutta, Satyandranarayan, Mech House, P.O. Jadavpur College, Calcutta 32.
 Dutta, Salil Kumar, 7E, Boloram Ghosh Street, Calcutta 4.
 Dutta Roy, Amitava, 6A, Lake Terrace, Calcutta 29.
 Dutt, (Miss) Anima, 32, Bhupendra Bose Avenue, Calcutta 4.
 Dutt, Asoka Kumar, Calcutta.
 Dutt, Pranabanānda, Presidency College, Calcutta.
 Dutt, Sudhamoy, Bangabashi College, Calcutta.
 Dutt Majumdar, Dwijish Kumar, 5th Year, Radio Physics, Roll. 12,
 Dutt, Kalyani,
 Dutt, Pritosh, Bangabashi College,
 Dutt, Ranjit K., Presidency College, Calcutta.
 Dutt, Parimal, Ripom College, Calcutta.
 Dutt, Ranjit K., Presidency College, Calcutta.
 Dutt, Narayan, Scottish Church College, Cal.
 Dutt, Saradindu, City College, Cal.
 Duggal, Premlata, 18, Raj Basanta Roy Road, Calcutta 26.
 Dubey, Satyadeb, Rajendra Nibas, Calcutta 23.
 Duari, Panchanon, Hardinge Hostel, Top Floor, Room No. 35, Calcutta 7.

E

- Ellathaw, Thomshy, Jadavpur Engineering College, Jadavpur.

F

- Farooq, Ahmed, Dept. of Zoology, Muslim University,

G

- Gangooli, Sukhendu, Scottish Church College, Cal.
 Ganguli, Kalipada, Eden Hindu Hostel, Calcutta 12.
 Ganguli, Subir, Science College, Cal.
 Ganguli, Rashbehari, Scottish Church College,
 Ganguli, S. K., City College, Calcutta.
 Gandhi, P. P., R. G. Kar Medical College, Calcutta.
 Ganguli, Prasanta, Physics, Dept.,
 Gogali, R. S., C/o. Head of the Chemistry Dept., Benaras Hindu University, Benares.
 Ganguli, Subrata, 12-1A, Hindusthan Park, Calcutta 29.
 Ganguly, Rabindra Nath, Zoological Laboratory, University College of Science, 35,
 Ballygunge Circular Road, Calcutta 19.
 Ganguly, Ramendra Nath, P-5, Belaghata Main Road, Calcutta 14.
 Ganguly, Sunata, Geology Dept., Presidency College, Calcutta 14.

- Ganguly, Taodhan, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Ganguly, Ashoke Kr., 42B, Chetla Road, Calcutta 27.
- Ganguly, Sudhir Kumar,
- Ganguly, Dhirendranath, 1/2C, Debi Srerampur Lane,
- Ganguly, Dhirendranath, 1-2C, Debi Srerampur Lane,
- Ghose, Milan Mukul, Medical College,
- Ghose, Subrato,
- Ghose, Biman Kr., Presidency College,
- Ghose, Juthika, Physiology Department (Hons.), Science College, Calcutta.
- Ghose, Salil K., 8/1/5, Loudon Street, Calcutta.
- Ghose, Ranjit, 45/1/A, Amherst Street, Calcutta.
- Ghose, Anil K., 9, Muralidhar Sen Lane, Calcutta.
- Ghose, Sibaprasad, 1/1, Gopal Bose Lane, Calcutta.
- Ghose, (Miss) Radha, Medical College, Calcutta.
- Ghose, Pritindra K., Science College, Calcutta.
- Ghose, Probhat Kumar, City College, Cal.
- Ghose, Bani, Science College,
- Ghose, Jayata K., Presidency College, Botany Dept.,
- Ghose, Sunit, Scottish Church College, Calcutta.
- Ghose, Subir K., Presidency College, Cal.
- Ghose, Roma, 6-1, Telipara Lane, Calcutta-4.
- Ghose, Chandra Kanta, Presidency College, Cal.
- Ghose, Subinta, 12, Badur Bagan Lane, Calcutta.
- Ghose, Gopi Kishna, 27, Maharsi Debendra Road, Calcutta.
- Ghose, Binoy Krishan,
- Ghose, Bani, Science College,
- Ghose, Sunit, Scottish Church College, Calcutta.
- Ghose, Jayata K., Presidency College, Botany Dept.,
- Ghose, Nikhilranjan, 3A, Mercus Lane, Calcutta.
- Ghose, Chandrachua, Presidency College, Calcutta.
- Ghose, Dhananjoy, 3, Peary Sarkar Street, Calcutta 12.
- Ghose, Samir Chandra, 12, Bhupen Bose Avenue, Calcutta 4.
- Ghose, Anandamohon, 6/1, Ashutosh Mookerjee Lane, Calcutta.
- Ghose, Bhaskar Kr., 33A, Kansaripara Road, Calcutta 25.
- Ghose, Saraj, Gauhati University,
- Ghose, Arunabha, Geological Laboratory, Presidency College, Calcutta.
- Ghose, (Sm.) Arundhati, 37-D, Puddapukur Road, Calcutta 20.
- Ghose, Debabrata, 15-1, Raja Basanta Roy Road, Calcutta 26.
- Ghose, M., Dept. of Civil Engineering, B. E. College, Howrah.
- Ghose, Suralali, Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta 19.
- Ghose Ray, S. K., C/o. J. K. Ghose Ray, Barasat P.O., 24-Parganas.
- Ghose, (Sm.) Tuhina, 26, Southern Avenue, Calcutta 26.
- Ghosh, Ajit Kumar, 157-4-1, Bakul Bagan Road, Calcutta 25.
- Ghosh, Amal Kumar, Biren Roy Road (East), Calcutta 8.
- Ghosh, Bhola Nath, Eden Hindu Hostel, 3, Peary Sircar Street, Calcutta 12.
- Ghosh, Dhirendralal, Canning Hostel, 35, Scott Lane, Calcutta 9.
- Ghosh, Gostha Behari, C/o. S. J. Netai Ch. Ghosh, P.O. Ichapore, Nawabganj, Jhulanta, 24-Parganas.
- Ghosh, Lal Mohan, Dept. of Psychology, Science College, 92, Upper Circular Road, Calcutta.

- Ghosh, (Miss) Mrinmoyee, Dept. of Radio Physics and Electronics, 92, Upper Circular, Road, Calcutta 9.
- Ghosh, Parimal, 9B, Lower Range, Calcutta 17.
- Ghosh, Pulak Kumar, 48-2, Ramtanu Bose Lane, Calcutta 6.
- Ghosh, (Miss) Rekha, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
- Ghosh, Rajendra Mohan, Dept. of Physiology, 92, Upper Circular Road, Calcutta 9.
- Ghosh, Subrata, Geological Laboratory, Presidency College, Calcutta 12.
- Ghosh, Samiran Kumar, 62, Raja Rajballav Street, Calcutta 3.
- Ghosh, Samir, 1-3C, Madan Baral Lane, Calcutta 12.
- Ghosh, Somnath, 19A, Raja Dinendra Street, Calcutta 9.
- Ghosh, Sukhendu Bikas, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
- Ghosh, Dwarika N., Medical College, Cal.
- Ghosh, Barasankar, The Park,
- Ghosh, Anathnath, P-32, Ganesh Ch. Avenue, Calcutta.
- Ghosh, Premtosh, City College,
- Ghosh, Sunit,
- Ghosh, Murarimohan, Scottish Church College, Calcutta.
- Ghosh, Anil K., City College,
- Ghosh, Mira, Presidency College, Cal.
- Ghosh, Anil K., Presidency College, Cal.
- Ghosh, Mukta Ranjan, Presidency College, Cal.
- Ghosh, Mira, Presidency College, Cal.
- Ghosh, Anil K., Presidency College, Cal.
- Ghosh, Mukta Ranjan, Presidency College, Cal.
- Ghosh, Manju, Presidency College, Cal.
- Ghosh, Sutapa, 6, Chaltapara Lane, Calcutta.
- Ghosh, Amiya Kanti, Presidency College, Calcutta.
- Ghosh, Sushit Kumar, 17, Raja Dinendra Street, Calcutta 9.
- Ghosh, Murarimohan, Scottish Church College, Calcutta.
- Ghosh, R. K.,
- Ghosh, Rathindra M., Bangabasi College, Cal.
- Ghosh, (Sm.) Uma,
- Ghorai, Jatindranath, 9, Bright Street, Calcutta 19.
- Ghorai, Sakti Prosad, Bangabashi College, Calcutta.
- Ghosal, Gopa, 3C, Nalin Sarkar Street, Calcutta.
- Ghosal, Ashit K., Calcutta National Medical College, Calcutta.
- Ghoshal, Brindaban Behari, Applied Physics (6th Year), Roll 32.
- Ghosal, Amiya Kumar, 27/1A, Dihi Serampur Road, Calcutta 14.
- Ghaffar, Amanullah,
- Godbole, E. W., C/o. Prof. S. S. Joshi, Head of the Chemistry Dept., Benaras Hindu University, Benaras.
- Goswami, Atanu, Geology Dept., Presidency College, Calcutta 12.
- Govindan, M., 78, New Hostel, Indian Veterinary Rech. Inst., New Delhi 5.
- Govindu, H. C., Agricultural College, Hebbal, Bangalore 6.
- Gooptu, Pronab, Student, E. E. & M. E. Dip., 89, Rashbehari Avenue, Calcutta 26.
- Gon, Ekkari, Presidency College Hostel,
- Gopalam, K., Patna Science College,
- Goswami, Nityananda 13, Girish Bidyaratna Lane, Calcutta 9.
- Goenka, Bharati, Presidency College, Cal.
- Guha, Shyamapada, Calcutta National Medical Institute, 32, Gora Chand Road, Calcutta.
- Guha, Sujit Kumar, Bijoygarh Colony, P. O. Jadavpur College.
- Guha, Amalendu, 31/13, Indrani Park, Calcutta.

- Guha, (Miss.) Bani,
 Guha, Arup K., Presidency College, Calcutta.
 Guha Roy, Saroj K., City College, Calcutta.
 Guha, Aloy K., Presidency College, Cal.
 Guha, Anilranjan, 3, Peary Sarkar Street, Calcutta 12.
 Guha, Sibjyoti, 35, Ballygunge Circular Road, Calcutta.
 Guha, Surajit, Presidency College, Cal.
 Guha, Dipak, 7, J.S.R. Das Road,
 Guha, (Miss) Ajana, 32J, Sahitya Parisad Street, Calcutta 6.
 Guha, (Miss) Ahana, 32J, Sahitya Parisad Street, Calcutta 6.
 Guha, Dilip, Geological Laboratory, Presidency College, Calcutta 12.
 Guha, (Miss) Gita, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Guha, Nirmal, 2, Sasibhusan Chatterjee Lane, Calcutta 2.
 Guha, Samarendra Nath, Eden Hindu Hostel, Calcutta 12.
 Guha, (Sm.) Sephali, 27, Dilkhusa Street, Calcutta 17.
 Guha, Tajendra Narayan, 5, Talpukur Road, Calcutta 10.
 Guha Biswas, (Miss) Usharani, P-61, Raja Naba Kisson St., Sovabazar, Calcutta 5.
 Guha Mullick, (Sm.) Anjali P-27, Raja Basanta Roy Road, Calcutta 29.
 Guha Niyogi, (Miss) N., 18-17, Fern Road, Calcutta 29.
 Guha Thakurta, Prabir, Y. M. C. A. Student Branch, 138, Kesab Sen St., Calcutta 9.
 Gupta, Partha Sarathi. Medical College, Cal.
 Gupta, Roma, City College,
 Gupta, Utpal,
 Gupta, Dharam Pal, 117, De Hostel, Banaras.
 Gupta, Amita, 57, Cossipore Road, Calcutta.
 Gupta, Jayati,
 Gupta-Sarma, Dharanjit,
 Gupta, Dilip, Presidency College, Calcutta.
 Gupta, Anadi Sankar, Presidency College, Calcutta.
 Gupta, N. P., Indian Institute of Science, Bangalore.
 Gupta, Ram Karam, City College, Calcutta.
 Gupta, J. N., Patna Science College,
 Gupta, Tapasi, P-25, Garcha 2nd. Lane, Calcutta 19.
 Gupta, Parimal, Calcutta National Medical Institute, 32, Gora Chand Road, Calcutta.
 Gupta, Sujoy, Botany Dept., Presidency College, Calcutta.
 Gupta, Purnendu K., Eden Hindu Hostel, Calcutta.
 Gupta, Amulya Bhusan 69-2-2, Surendra Nath Banerjee Road, Calcutta 14.
 Gupta, Amitava, 28-C, Pratapaditya Road, Calcutta.
 Gupta, Amritava, 87, Bondel Road, Calcutta.
 Gupta, Devendravihay, 17, Naskarpara Lane, Sibpore, Howrah.
 Gupta, Milan Kumar, 3, Peary Sircar Street, Calcutta 12.
 Gupta, Pejush Kanti, 6-2, Kirti Mitter Lane, Calcutta.
 Gupta, Pranab Kumar, C/o. Sri S. K. Gupta, 9-1, Hungerford Street, Calcutta 16.
 Gupta, P. R., C/o. Dr. P. C. Guha, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Gupta, R. C., C/o. Dr. P. C. Guha, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Gupta, S., Dept. of Civil Engineering, B. E. College, Howrah.
 Gupta, Subir, 302, Upper Circular Road, Calcutta 9.
 Guin, Subir, Y. M. C. A. College Branch.
 Guin, Mihir Baran, Presidency College, Cal.

Guin, Mihir Baran, Presidency College, Cal.

Gyani, Gopal, Patna Science College,

H

Hajra, Bansidhar, Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta 19.

Halder, Ajit Kumar, 5, Raja Sew Box Bagala Lane, Tala, Calcutta 2.

Hariharan, K., 18, Janak Road, Calcutta 29.

Hasanzaidi, S. T., Forest View Hostel, Nawabgunj, Kanpur.

Hazarika, Jokeswar, Post Graduate, Calcutta University, Calcutta.

Hazarika, Jatin, Hardinge Hostel, Calcutta 7.

Hazarika, Prodip, Gauhati University, Assam.

Haidar, Talukdar Oman, Botany Dept., Presidency College, Calcutta.

Haider, Talukdar Oman, Botany Dept., Presidency College, Calcutta.

Haque, Zaiul, Gauhati University,

Hiralal, City College,

Hora, R. B., I.C.A.R., Delhi.

Hore, Mrinal K., Room 62, Hardinge Hostel, Calcutta.

Hota, A. K., C/o. Prof. S. S. Joshi, Head of the Dept. of Chemistry, Benaras Hindu University, Benaras.

House, K. B., Kathgore Station, Cuttack 2.

Hu, C. T., Anthropology Dept., 4th Year Student, C/o. P. G. Mess, 35, Ballygunge Circular Road, Calcutta 19.

Huq, Rafiul, Dept. of Physics, Cotton College, Assam.

I

Islam, Saigul, 66, Lower Chitpur Road, Calcutta 1.

Iyengar, J. R., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.

Iyengar, M. A. Narayan, All India Institute Hygiene & Public Health.

J

Jacob, K., Christ Church College, Canpur.

Jana, Bipin Behari, Medical College, Calcutta.

Jain, Ratanlal, City College, Calcutta.

Jasaharlal, City College, Calcutta.

Jacob, E. John, Research Student, Division of Applied Chemistry, Central Research Inst., Trivandram.

Jacob, Joseph, Research Scholar, Annamalai University, Annamalai Nagar.

Jain, Dhirubhai 'Eastern Court', Suit No. 33, P-29, Mission Row Extn., Calcutta 1.

Jain, Panna Lal, Geological Laboratory, Presidency College, Calcutta 12.

Jain, S. P., Chemistry Division, Indian Agriculture Rech. Inst., New Delhi.

Jain, Tikam Chand, 66, Nalini Sett Road, Calcutta 7.

Jata, D. P., C/o. Head of the Chemistry Dept., Benaras Hindu University, Benares.

Jayasimha, B. N., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.

Joshi, G. N., St. Paul's College, Calcutta.

- Johry, Kailash N., Research Student, Chemistry Dept., Lucknow University, Lucknow.
 Joshi, Girish, C., Fellowship Student, Central Research Section, Hercourt Butler
 Technological Institute, Kanpur.
 Joshi, M. A., Chemistry Dept., Fergusson College, Poona 4.

K

- Kapas, Kamala Charan, 43/1, Strand Road, Calcutta 7.
 Kapadia, V. H., Biochemistry Dept., The Institute of Science, Fort, Bombay 1.
 Kapur, B., Dept. of Civil Engineering, B. E. College, Howrah.
 Kapoor, Bhagat Gopal, Dept., of Zoology, University of Delhi, Delhi 8.
 Kar, Naresh Chandra, Carmichael Medical College, Calcutta.
 Kar, Anita,
 Kar, Murarimohan,
 Kar, (Sm.) Basanti, 34A, Jatindas Road, Calcutta 29.
 Kar, (Miss) S., 17/1, Lansdown Terrace, Calcutta 26.
 Karmakar, Anil Kumar, L/50A, Narikeldanga Rly. Colony, Calcutta 11.
 Kashyap, Virandra Nath, 24, Benaras Road, Salkia, Howrah.
 Kathirgamathamby, S., Ogilvie Hostel, 31/2, Hurtuki Bagan Lane, Calcutta 6.
 Kayal, Gouranga Das, Eden Hindu Hostel, Room No. 50, Calcutta 12.
 Karyan, Edna Mary.
 Karia, Sashikanta, Scindia School, Gwalior.
 Karan, Shubh, City College, Calcutta.
 Kaushik, D. K., Central Fisheries, Barrackpur.
 Kapoor, M. N., I.C.A.R., Delhi.
 Kaul, Chunilal, 14A, Jagadish N. Roy Lane, Calcutta.
 Kelkar, S. V., C/o. Head of the Dept. of Chemistry, Benares Hindu University,
 Benares.
 Keshkar, V. R., Chemistry Dept., Fergusson College, Poona 4.
 Ketton, Bhawalal, 46, Cotton Street, Calcutta 7.
 Khamreej, Sudhir Ranjan, 10A, Dinabandhu Lane, Calcutta.
 Khan, Amanullah, Forest View Hotel, Kanpur, U. P.
 Khanna, Jatindra Mohan, Presidency College, Cal.
 Khaitan, Hargovind, City College, Cal.
 Khemka, Mata Dien, 1, Ballyganj Place, Calcutta 19.
 Khoured, Manik, Hardinge Hostel, Calcutta 7.
 Khigha, Mukurkanti, Presidency College,
 Khonolkar, (Dr.) D. D., Bombay.
 Khasgiwalla, K. K., Dept. of Chemistry, University of Poona, Poona 4.
 Khare, K. N., C/o. Prof. S. S. Joshi, Head of the Dept. of Chemistry Dept., Benares
 Hindu University, Benares.
 Khare, M. P., C/o. Dr. V. S. Misra, Lecturer in Chemistry, Lucknow University,
 Lucknow.
 Kishat, R., Patna Science College,
 Kisdnasamy, S., 2, Store Road, Calcutta 19.
 Kowjalgi, M. V., C/o. Dr. P. C. Guha, Dept. of Organic Chemistry, Indian Institute
 of Science, Bangalore 3.
 Koyal, Sankar Nath, 16/1, Komedan Bagan Lane, Calcutta 16
 Kole, Dwijendra N., Scottish Church College, Cal.
 Kolay, Khudiram, 171, Bowbazar Street, Calcutta.
 Konwar, Ranjit Singh, Presidency College, Calcutta.

- Krishnamurthi, S., 123, B. H. Hall, Madras Christian College, Tambaram, Madras.
 Krishnamurthy, D. V. R., 36B, Sarkar Road, Calcutta.
 Kulkarni, N. R., C/o. Head of the Dept. of Chemistry Benares Hindu University Benares.
 Kulkarni, P. S., C/o. Chemistry Dept., Fergusson College, Poona 4.
 Kumar, Amarendra Nath,
 Kumar, Jauanti, Patna Science College,
 Kumar, Amal Behari, 42/8, Doctor Lane, Calcutta 14.
 Kumar, Vijaya, Victoria College, Gwalior.
 Kumarasamy, Ganesan, St. Paul's College, Calcutta.
 Kururmoorthy, Manikkam, St. Paul's College, Calcutta.
 Kundaji, Suresh, C/o. Sri K. Deva Rao, 7, New Road, Flat No. 8, Calcutta 27.
 Kuriakose, J. C., Research Student, Chemistry Laboratory, Loyola College, Madras 6.
 Kundoo, Indu Sekhar, Science College, Calcutta.
 Kundu, Kiron Kumar, 18, Jadu Nath Mullick Road, Calcutta 6.
 Kundu, Nakuleswar, Dept. of Pure Chemistry, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Kundu, Amiya Kr.,
 Kundu, Panchu Gopal, Botany Dept., Presidency College, Calcutta.
 Kundu, Gangadhar Prosad, Presidency College, Cal.
 Kundu, G., 1, Krishna Kundu Street, Calcutta 5.
 Kundu, S., 14B, Gora Chand Road, Calcutta 14.
 Kundu, A., 422, Kalighat Road, Calcutta 26.
 Kundu, Bimal Kr.,
 Kundu, Phatik Chandra, Presidency College, Calcutta.
 Kundu, Rabindra, Presidency College, Calcutta.
 Kundu, Arabindu, Presidency College.
 Kundu, Hirendralal, Science College, Calcutta.

I.

- Laha, B. K., Dept. of Civil Engineering, B. E. College, Howrah.
 Laha, (Miss) Snehalata, Depts. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Lala, P. City College,
 Lal, Rama Shankar, Indian Statistical Institute, Cal.
 Lal, B. M., The Food Technology Laborator, Indian Institute of Science, Bangalore 3.
 Lal, Amir, Bangabasi College, Calcutta.
 Lahiri, Asoke Kr., Botany Dept., Presidency College, Calcutta.
 Lahiri, Phalgunimohon, Ripon College, Calcutta.
 Lahiri, Arun Kumar, C/o. City College, 102/1, Amherst Street, Calcutta 9.
 Lahiri, Dinabandhu, 323, Victoria Road (South), Calcutta 36.
 Lahiri, Sukhamay, 44-2, Lansdown Road, Calcutta 20.
 Lahiri, Sanjoy Kumar, 24, Sir Gurudas Road, Calcutta 11.
 Lahiri, Asoke Kr., Botany Dept., Presidency College, Calcutta.
 Lodha, U. S., R. G. Kar Medical College, Calcutta.
 Lyngdra, Sparbah,
 Laksymanan, C., Dept. of Botany, Annamalai University, Annamalainagar.
 Laskar, A., Dept. of Civil Engineering, B. E. College, Howrah.
 Laud, B. B., Research Asst., C. B. I. R., Spectroscopic Laboratories, Institute of Science, Bombay 1.
 Lyngdoh, Evelyn, Y. W. C. A., 134, Corporation Street, Calcutta 13.

M

- Mallik, (Miss) Jyoti, 144, Nara Singha Dutta Road, Howrah.
 Mallick, Mrinal Kanti, Presidency College, Cal.
 Mallick, Bimal K., 60, Kalutola Street, Calcutta 1.
 Mallik, Nityananda, Surendranath College, 288-1, Upper Circular Road, Calcutta.
 Mandal, Amulya,
 Mandal, Joideo, Bangabasi College, Calcutta.
 Mandal, Rishiti Ballav, City College, Calcutta.
 Mandal, Surendra N., 17, Bagmari Road, Calcutta.
 Mandal, Nabagopal, 2B., St. James Square, Calcutta 12.
 Mandal, Prafulla, 61-1E, Wellington Street, Calcutta.
 Mandal, Jatindra M., Medical College, Cal.
 Mandal, Jatindranath, Medical College, Calcutta.
 Mandal, Sukumar, 4, Thakurdas Palit Lane, Calcutta.
 Mandal, Nirmalendu, City College,
 Mandal, Gopal Ch., Bangabasi College, Calcutta.
 Mandal, Nabagopal, 3B, St. James Square, Calcutta 12.
 Mandal, Kripacharyya, 8, Panchanan Ghosh Lane, Calcutta 9.
 Majumder, Sisir Kr., City College, Calcutta.
 Majumdaer, (Mrs) Anita,
 Majumdar, 141/2C, South Sinthi Road, Calcutta 2.
 Majumdar, Geeta, 20, Dum Dum Road, Calcutta 2.
 Majumdar, Mrinmoyee, Surendranath College,
 Majumdar, Rupendra K., 102, Amherst St., Calcutta 9.
 Majumdar, Shyamal Kumar, P-124, Lake View Road, Calcutta 29.
 Majumdar, (Sm.) Arati, 6A, Abhoy Guha Road, Calcutta 6.
 Majumdar, Ashis Kumar, 29, School Row, Calcutta 25.
 Majumdar, Gitindra Kumar, Dept. of Geography, Senate House, Calcutta 12.
 Majumdar, Narrendra Narain, Dept. of Zoology, University of Delhi, Delhi 8.
 Majumdar, Rajarshi, 123, Bowbazar Street, Calcutta 12.
 Majumdar, Sandip Kishore, 2C, Hyat Khan Lane, Midland Hotel, Sealdah P. O., Calcutta.
 Mazumdar Dalim Kumar, Eden Hindu Hostel, Room No. 52, 3, Peary Sarkar Street, Calcutta 12.
 Majumdar, Nirmalya Kumar, 1st Year Science, Sec. 'D,' Roll. 99, Bangabasi College, Calcutta.
 Mazumdar, B. N., Indian Institute of Science, Bangalore.
 Mazumdar, Dinesh Chandra,
 Mazumdar, Ajit, Eden Hindu Hostel, Calcutta.
 Mazumder, Benu, C/o. Dr. Sarma,
 Mazumder, Malabika,
 Mazumdar, Benoy, Presidency College, Cal.
 Mazumdar, Shusantamoy, C/o. Dr. N. R. Sarkar, 43, Dharamtolla Street, Top Floor, Calcutta 6.
 Mazumdar, Mainak, Presidency College, Calcutta.
 Mahapatra, Provakar, 1A, Maharani Swarnamoyee Road, Calcutta 9.
 Mahapatra, Debabrata Kar, 9, Bright Street,
 Maitra, Jayanta P., Presidency College, Cal.
 Maitra, Nanigopal,
 Maitra, Gouri, P.81, Lake Road,
 Maitra, Pabitra K., Presidency College,

- Maitra, Saroj K., City College, Calcutta.
- Mal, Anath Bandhu,
- Mal, Sunil Kr., Bangabasi College, Calcutta.
- Mahendra, A., Bengal Veterinary College,
- Mawandia, Hari Prasad, City College, Calcutta.
- Mahanti, Bibhuti Bhusan, 45-1A, Amherst Street, Calcutta 9.
- Mahanti, Prahlad Chandra, 102, Amherst Street, Calcutta 9.
- Mahoto, Ramavatar, 50, Kali Krishna Tagore Street, Calcutta 7.
- Mahmood, Anwar Bin, Bengal Veterinary College,
- Mania, Provakar,
- Maker, Sankar P., Murarichand College,
- Maity, Purnendu, Vidyasagar College, Calcutta.
- Malakar, Chitta R., Presidency College, Calcutta.
- Malkhandy, B. B., Calcutta National Medical Institute, Calcutta.
- Mawandia, Purnan,
- Maulick, Barun Kanti, C/o. Sri, B. C. Maulick, 308, Gopal Lal Tagore Road, Calcutta 36.
- Malik, Fazley Bary, Room No. 162, Baker Hostel, 8, Smith Lane, Calcutta.
- Marathe, B. R., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
- Mathu, S., Dept. of Applied Chemistry, General Chemistry Section, Indian Institute of Science, Malleswaram, Bangalore.
- Mathur, Bhagwan Behari Lal, Dept. of Zoology, University of Delhi, Delhi.
- Mathur, G. P., C/o. The Director, Indian Institute of Sugar Technology, Kanpur.
- Mathur, J., General Chemistry Section, Indian Institute of Science, Bangalore 3.
- Madan, M.P., Lucknow.
- Mahapatra, Lakshman Kumar, Dept. of Anthropology, University of Calcutta, Calcutta.
- Mahapatra, S. N., Chemical Laboratory, Ravenshaw College, Cuttack.
- Mahadevan, P.S., Research Student, Division of Applied Chemistry, Central Rech. Inst., Trivandrum.
- Maity, Madhu Sudan, Mech House, P.O. Hadavpur College, Calcutta.
- Mehta, V. Trambak Lal, R. G. Kar Medical College, Calcutta.
- Medda, Ajit Kumar, Dept. of Physiology, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Meenakshi, V.R., Research Student, Annamalai University, Annamalainagar.
- Medhi, B.C., Dept. of Civil Engineering, B. E. College Howrah.
- Mehta, K.L., Botany Dept. Delhi University, Delhi 8,
- Mehera, Shyamlal, 5-B, Jwliatola Street, Calcutta 6.
- Mehrotra, R.R., Research Scholar, Engineering College, Benares Hindu University, Benares.
- Mitra, (Miss) Amita, 2, Rajnarayan Biswas Lane, Calcutta 5.
- Mitra, Bomkesh, Medical Hostel, 73, Dharamtolla Street, Calcutta.
- Mitra, Jagadish, Research Scholar, Chemistry Dept., Lucknow University, Lucknow.
- Mitra, Samar, 122/1, N. P. Road, Ghusray, Howrah.
- Mitra, Somendra Kumar, 96, Khetra Benerjee Lane, P. O. Sibpore, Howrah.
- Mitra, Sunanda, 53/B, Haris Mookherjee Road, Calcutta 25.
- Misra, Susanta Kumar,
- Misra, Sudhakar, Bengal Veterinary College, Class 'A' Roll 42.
- Misra, Sunil Kumar,
- Misra, Nand K., Vidyasagar College, Cal.
- Misra, Hitendranath, Presidency College Calcutta.
- Mitra, Mridul, 29F, Creek Row, Calcutta.

- Mitra, Bhola Nath, Dhanbad Mining Engineering College, Dhanbad.
 Mitra, Niten Kumar, R. G. Kar Medical College,
 Mitra, Shyamal 286/A, Rash Behari Avenue, Calcutta 29.
 Mitra, K. K., Patna Science College,
 Mitra, Dipak Kumar,
 Mitra, Dilip Kumar,
 Mitra, Arabinda, 105, Vivekananda Road, Calcutta 6.
 Mitra, Joy Narayan, 143, Raja Ranendra Lal Mitra,
 Mitra, Krishna,
 Mitra, Arabinda, 105, Vivekananda Road, Calcutta 6.
 Mitra, Tapan, City College, Calcutta.
 Mitra, Deb Kumar, Surendranath College, 288-1, Upper Circular Road, Calcutta.
 Mitra, Dilip K., Vidyasagar College, Cal.
 Mookherjee, Asoke, 21A, Mohonlal Street, Calcutta.
 Mookerjee, Lalmohan, 178, Bowbazar Street, Calcutta 12.
 Mookerjee, Prabir Kumar, 73, Dharmotolla Street, Nilratan Sarkar Medical College
 Hostel, Calcutta.
 Mookerjee, Promode Gopal, C/o. S. J. M. G. Mookerjee, P. O. Garulia, Dist.
 24 Parganas:
 Mookerjee, Ranjit, 54, Madhu Sudhan Biswas Lane, Howrah.
 Mookerjee, Sailen, 32B, Radhakanta Jew Street, Calcutta 4.
 Mookerjee, Sanat Kumar, 21, Baje Shibpore Road, Howrah.
 Mookerjee, Santanu, 4, Cooper Street, Calcutta 26.
 Mookerjee, Surapriya, 2, Surunath Das Lane, Calcutta 12.
 Mookerjee, Tapan Kumar, 52, Ashutosh Mookerjee Lane, Salkia, Howrah.
 Mookherjee, Shyamal Krishna,
 Mookherjee, Sunil Kr., P. G. Class, University of Calcutta, Cal.
 Mookherjee, H. R., Bengal Veterinary College,
 Mookherjee, Amita, C/o. Dr. Sarma,
 Mookherjee, Ajit, Science College, Cal.
 Mookherjee, Presidency College, Calcutta.
 Mookherjee, Monoj K., Presidency College, Cal.
 Mookherjee, Rama Prosad, Presidency College, Cal.
 Mookherjee, Saradindu, Presidency College, Cal.
 Mookherjee, Chirantan, Presidency College, Calcutta.
 Mookerjee, Rabindra Kumar, Botany Dept. Presidency College, Calcutta.
 Mookerjee, Rabindra Kumar, Botany Dept., Presidency College, Calcutta.
 Mookerjee, Sakti Kr., Presidency College,
 Mookerjee, Mrinalkanti, Vidyasagar, College, Calcutta.
 Mookerjee, Amal Kr., 8B, Rajani Sen Road, Calcutta 26.
 Mookerjee, Mihirbaran, 3rd Year, Science, City College, Calcutta.
 Mookerjee, Satyendra Kr., Eden Hindu Hostel, Calcutta 12.
 Mookerjee, Shambhunath, 47B, Iswar Ganguly Street, Calcutta 26.
 Modi, Daya Nidhi, Room No. 6, Harrison Road, Calcutta.
 Mohan, G.R., Research Student, Chemistry Laboratory, Loyola College, Madras. 6.
 Mohanty, Guru Prosad, C/o. H. B. Mohanty, Dy. Magistrate, Sahi, Cuttack.
 Mohanty, S.C., C/o. Prof. S. S. Joshi, Head of the Dept. of Chemistry, Benares Hindu
 University, Benares.
 Mohanty, (Dr) S. R., C/o Prof. S. S. Joshi, Head of the Dept. of Chemistry, Benares
 Hindu University, Benares.
 Modi, Shaligram, City College, Calcutta.
 Mondal, Harendra Nath, 6th Year, Geography, Calcutta University, Calcutta.

Mondal, Radharani, City College, Calcutta.

Mondal, Satyendra Kumar, 4th Year, Science, Sec., 'C' Roll. 181, Bangabasi College, Calcutta.

Mondol, S., 102, Amherst Street Calcutta 9.

Mondal Kartik Ch. Raghunathpur Singur, Hooghly.

Mondal, Haripada, Presidency College, Calcutta.

Mondol, Dijendra N., 17, Cornwallis Street, Calcutta.

Moolkey, Malati, Botany Dept., Presidency College, Calcutta.

Mohanty, Madhu Sudhan, City College, Calcutta.

Moolkey, Malati, Botany Dept., Presidency College, Calcutta.

Mukherjee, Ajit Kumar, Dept. of Pure Chemistry, University College of Science, 92, Upper Circular Road, Calcutta 9.

Mukherjee, Amar Nath, 30, Kalidas Patitundi Lane, Calcutta 26.

Mukherjee, (Sm) Anjali, 166, Bowbazar Street, Calcutta 12.

Mukherjee, Benoy Charan, 2, Nayayratna Lane, Calcutta 4.

Mukherjee, Biswa Mohan, Dept. of Geography, Senate House, Calcutta 12.

Mukherjee, (Sm) Dipali, Calcutta.

Mukherjee, Dinesh Ranjan, 26/C, Simla Street, Calcutta 6.

Mukherjee, Kashi Nath, 30, Kalidas Patitundi Lane, Calcutta 26.

Mukherjee, (Mrs.) Leena, Dept. of Education, 95, Russa Road, Calcutta 26.

Mukherjee, (Mrs.) Namita, 3, Swarnalata Street, Calcutta 26.

Mukherjee, Nilendu, Geological Laboratory, Presidency College, Calcutta 12.

Mukherji, Nirendra Nath, Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta 19.

Mukherjee, P., Dept. of Civil Engineering, B. E. College, Howrah.

Mukherjee, Prabhas Kumar, 62, Dr. S. N. Mukherjee Street, P. O. Uttarpara, Dist. Hooghly.

Mukherjee, Priya Ranjan, 28, Ahritola Street, Calcutta 5.

Mukherjee, Pasupati, 11, Ekdalia Place, Calcutta 19.

Mukherjee, Pratip Kumar, Geology Dept., Presidency College, Calcutta.

Mukherjee, Prafulla Ranjan, Eden Hostel, 3, Peary Sircar Street, Calcutta 12.

Mukherjee, Ranjit, Kumar, 4/10, Ekdalia Road, Calcutta 19.

Mukherjee, Sudhindra Nath, Dept. of Geography, Senate House, Calcutta 12.

Mukherjee, Tarak Nath, 62, Circular Road, Khurut P.O., Howrah.

Mukherjee, A. K., 116/1A, E. G. Road, Calcutta 20.

Mukherjee, Subil K., Surendranath College, Calcutta.

Mukherjee, Kastur, Medical College, Calcutta.

Mukherjee, Parimal, 95, Russa Road, Calcutta 26.

Mukherjee, Upendra Nath,

Mukherjee, Joynarayan, 16-1B, Ganesh Sarkar Lane, Calcutta.

Mukherjee, Abhoyapada,

Mukherjee, Ajit, N. S. Med. College,

Mukherjee, Sabita, 95, Russa Road, Calcutta 26.

Mukherjee, Dulal Ch., City College,

Mukherjee, Santi Chandra, Botany Dept., Presidency College, Calcutta.

Mukherjee, Jnnadananda, Presidency College, Calcutta.

Mukherji, Visvapriaya, 138, Keshab Sen Street, Calcutta 9.

Mukhopadhyay, Narayan,

Mullick, Kamalesh Kumar,

Mullick, Chitra,

Mullick, Arun Kumar, Botany Dept., Presidency College,

Mustafi, Mukul K., Bangabashi College, Calcutta.

Murti, K. S., Osmania University,

Murthy, D. R. Krishna, Central Fisheries, Barrackpur.
 Muragasoo, Sikunanthan, St. Paul's College, Calcutta.
 Mukhopadhyah, Suproakash, 8/1B, Suri Lane, Calcutta 14.
 Mulay, (Mrs.) I.L., C/o. Dr. L. N. Mulay, Dept. of Chemistry, Institute of Science, Bombay 1.
 Munshi, Deba Brata, 17/1A, Chaku Khansama Lane, Calcutta 9.
 Mundhra, Mahesh Das, 60B, Ratan Sarkar Garden Street, Calcutta 7.

N

Naha, Kshitindramohan, Presidency College,
 Nath, Hiranmoy, Dept. of Physics, Cotton College, Assam.
 Nath, Deba Prasad,
 Nath, Gobinda Nandan, Dept. of Physics, Cotton College, Assam.
 Nath, Dilip Kumar, C/o City College, 102-1, Amherst Street, Calcutta 9.
 Nath, Mohini Mohan, 6-A, Sanatan Seal Lane, Calcutta 12.
 Nath Amalkanti, Dept. of Biochemistry, Nagpur, University, Nagpur 1.
 Nath, Gopal Chandra, R. G. Kar Medical College, Calcutta.
 Nag Chaudhury, Bishnu Deb,
 Nag, Amal, Barisha College,
 Nag, B.,
 Nag, Asoke, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Nag, Biswajit, Dept. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Nag, Chitta Ranjan, 1-1, Kaliprosad Chakravarty Street, Calcutta 3.
 Nag, Kshounish Chandra, 172/11, Lower Circular Road, Calcutta 14.
 Nag, Panchanan, Geological Laboratory, Presidency College, Calcutta 12.
 Nag, (Mrs.) Preeti, 40/1, Chanditola Lane, Calcutta 33.
 Nag, S., Dept. of Civil Engineering, B. E. College, Howrah.
 Nag, (Miss) Uma Manjula, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Nag Chaudhurj, Jayanti, 12, Mohan Lal Mitra Lane, Calcutta 4.
 Nagarajan, R., 6th Year, Applied Chemistry, Calcutta University, Calcutta.
 Nadarajah, S., St. Paul's College, Calcutta.
 Nand, Ch. B. N., C/o. Prof. S. S. Joshi, Head of the Department of chemistry, Benares Hindu University, Benares.
 Nayyar, V. Krishna, R. G. Kar Medical College, Calcutta.
 Naldu, R. D., Science College, Calcutta.
 Nandi, Sakti Prosad, Presidency College, Cal.
 Nandy, Sirish Ch. Motijhil, Dum Dum.
 Nandy, Debabrata, City College, Cal.
 Nandy, Dilip K., Bangabashi College, Calcutta.
 Nandy, Satyabrata, Science College, Cal.
 Nandy, Anutosh, Hindu School, Calcutta.
 Nandy, Arun Kumar, Jadavpur Engineering College, Jadavpur.
 Nandy, Mohan Lal, 20/1E, Brindaban Bysack Street, Calcutta 5.
 Nandy, Santosh Kumar, Eden Hindu Hostel, Calcutta 12.
 Nandi, D.K., Food Technology Laboratory, Indian Institute of Science, Bangalore 3.
 Nandi, Dipil Kumar, 9, Indian Mirror Street, Calcutta 13.
 Nandi, Himangsu Bhusun, Eden Hindu Hostel, 3, Peary Sarkar Street, Calcutta 12.
 Narayan, Gour, Zoological Laboratory, 35, Ballygunge Circular Road, Calcutta 19.

Naik, Ramanlal Maganlal, The Institute of Science, Mayo Road, Fort, Bombay.
 Nayak, Bimbadhar, Chemistry Dept., Revenshaw College, Cuttack.
 Nayak, Ananda Prosad, Bangabasi College, Calcutta.
 Nayak, K.V., C/o Head of the Dept. of Chemistry, Benares.
 Nayak, U.G., C/o. Dr. P. C. Guha, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Nayar, K.V., Dept. of Chemistry, Lucknow University, Lucknow.
 Nayer, Chandra Sekhar, 10K, Russa Road, Calcutta 26.
 Neelkantam, L., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Neni, M.W., Chemistry Dept. Fergusson College, Poona 4.
 Neogi, Jnanabrata, N. R. Sarkar Medical College Hostel, 73, Dharamtolla Street, Cal.
 Niyogi, Salil Kumar, 6, Srish Ch. Chowdhury Lane, Calcutta 2.
 Narasimha, M. S., All India Institute Hygiene & Public Health.
 Nahar, Durgamal, City College, Calcutta.
 Narayan, K. N., Osmania University,
 Narayan, Lakshmi, Presidency College,
 Neogy, (Miss) Baby, 6-7C, Lower Circular Road, Calcutta.
 Niazi, Iqbal, Dept. of Zoology, Muslim University,
 Nodesan, Arumuga, St. Paul's College. Calcutta.

Ojha, Bibhuti Bhusan, Surendranath College, Calcutta.
 Ojha, Atul Ch., Scottish Church College,

Pal, Nirode,
 Pal, Satyabrata, R. G. Kar Medical College, Cal.
 Pal, Prafulla Chandra, Calcutta University, Calcutta.
 Pal, Kalipada, 44/22, B. T. Road, Calcutta 26.
 Pal, Sulata, Presidency College, Cal.
 Pal, Sulata, Presidency College, Cal.
 Pal, Joydeb Ch., Science College, Calcutta.
 Pal, Madan Mohan, 29, Nalini Sett Road, Barabazar, Calcutta.
 Pal, Subarna Jyoti,
 Pal, Bobindadas, 30, Mirzapur Street, Calcutta.
 Pal, Madhabendra Nath, 302, Upper Circular Road, Calcutta.
 Pal, Dulal Ch., Garpara Road, Calcutta.
 Pal, Sunil Krishna, Eden Hindu Hostel, Calcutta 12.
 Pal, Ajit Kumar, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Pal, Anil Kumar, O-149, Mudialy Road, Garden Reach, Calcutta 24.
 Pal, Anil Kumar, C/o. S.J. Sriharan Pal, Dutt's Lane, Chinsurah, Hooghly.
 Pal, (Sm.) Labanya Prova, 11/1C, Arpuli Lane, (First Floor), Calcutta 12.
 Pal, Sambhu Nath, C/o. Jogendra Nath Pal, Barasat P.O., 24-Parganas.
 Paul, Ramendranath,
 Paul, Manoj Kumar,
 Paul, Basana, City College,
 Paul, Pradyot Kumar, C/o. Sri. S. K. Paul, 1st. Floor, Suit No. 2, 172-15D, Lower Circular Road, Calcutta.

- Paul, Phanindra N., Vidyasagar College, Cal.
 Palit, Ashis, Presidency College, Calcutta.
 Palit, Probhat Ch., Surendranath College,
 Pain, Sunil Kumar, Dept. of Physiology (Student), Presidency College, Calcutta.
 Pain, Ashis Kumar, Eden Hindu Hostel, Calcutta.
 Parekh, Biren,
 Panda, Jainya Datta, 2A, Pudda Pukur Road, Calcutta 20.
 Pande, S.K.D., D/2, B. M. U. Quarters, Benares 5.
 Pandeya, Satish Chandra, Botany Dept., University of Saugar, Saugar.
 Pandhi, S.C., C/o. Prof. S. S. Joshi, Head of the Chemistry Dept., Benares Hindu University, Benares.
 Pandit, G.M., C/o. Head of the Chemistry Dept., Benares Hindu University, Benares.
 Pandit, Rabindra Nath, 15, Fordyce Lane, Calcutta 14.
 Parikh, R.G., Mehta Park, Ambawadi, Ellis Bridge, Ahmedabad 6.
 Patna, M. J., L. D. Arts College & M. G. Science Institute, Navarangapura, Ahmedabad 9.
 Patra, Asit Baran, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Patra, G.M., C/o. Prof. S.S. Joshi, Head of the Chemistry Dept. Benares Hindu University, Benares.
 Padmanabhan, 52B, Lake Place, Calcutta 29.
 Patankar, S. K., Dhana Mistri's Ghol, Methajis Mala, Bhusawal, E. K.
 Paneswar, B. R.,
 Patra, Nityananda Patra, 27C, Amharst Street, Calcutta 19.
 Pany, Rajani Bhusan,
 Panda, Ramesh Chandra, Vidyasagar College, Calcutta.
 Perilwal, Hari Prasad, City College, Calcutta.
 Phansalkar, G.R., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
 Phukon, (Miss) Anjali, C/o. Sjt. J. P. Chaliha, P-21, Golf Club Road, Calcutta 33.
 Fodder, Madhabendra, 5-D, Hemkar Lane, Calcutta 5.
 Poddar, Motilal, Naskarpara Jute Mill, Ghusni, Howrah.
 Poddar, Sailendra Nath, Dept. of Pure Chemistry, University College of Science, 92, Upper Circular Road, Calcutta 9.
 Poddar, Ajoy Kanti,
 Podder, Rajendra P., Bangabasi College,
 Poddar, Mrigendra N., Eden Hindu Hostel, Calcutta.
 Poddar, Angur, Presidency College, Cal.
 Poddar, R. K., Presidency College, Cal.
 Podder, Nalini Roy, 61/1E, Wellington Street, Calcutta.
 Prosad, J., Patna Science College,
 Prosad, Shyam Behari, Scottish Church College, Calcutta.
 Prosad, Kanahaiya, Surendranath College, Calcutta.
 Prosad, Kameswar, Bangabasi College, Calcutta.
 Prasad, Dharamdeo, R. G. Kar Medical College, Cal.
 Prasad, Durga, City College, Calcutta.
 Prasad, Raghunath, City College,
 Pramanik, Paramananda, 85, Bowbazar Street, Calcutta.
 Prasad, S. N., Patna Science College,
 Prasad, R. S., Patna Science College,
 Prasad, N. K., Bangabasi College, Calcutta.
 Prasad, A. A., I.C.A.R., Delhi.
 Prasad, T., I.C.A.R., Delhi.
 Prodhan, Sellma, Presidency College, Calcutta.

- Prosad, Sushila, City College,
 Prosad, Ram Chandra, Presidency College, Cal.
 Prasad, Ramabatar, Bangabashi College,
 Prosad, Shivanandan, 14/A, Shambhu Chatterjee Street, Calcutta 12.
 Prosad, Sheo, Bangabasi College, Calcutta.
 Prasad, Rajendra, Eden Hindu Hostel, Calcutta 12.
 Pramanik, Nirmal Kumar, 1-B, Hara Chand Mallick Lane, Calcutta 5.
 Pramanik, Pran Ballav, 8, Bright Street, Calcutta 19.
 Pruthi, (Master), 12, Akbar Road, New Delhi.
 Purkait, Sarbani Bhusan, 95, Russa Road, Calcutta 26.
 Purohit, Bhagaban Das, Presidency College, Cal.
 Purkati, Atul K., Bangabasi College, Calcutta.
 Puri, T. R., I. C. A. R., Delhi.
 Purkayastha, (Sm.) Mira, Rajpur G. H. S., Sonarpur P. O., Rajpur Vill, 24-Parganas.
 Purakayastha, (Sm.) Purnima, Dept. of Education, 95, Russa Road, Calcutta 26.
 Pyne, K. C.,
 Pyne, Chandra Kishore, University College of Science, Zoological Dept. 35,
 Ballygunge Circular Road, Calcutta 19.

Q

- Quader, Habibul, Dept. of Physics, Cotton College, Assam.

R

- Raghavan, M., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Rajadhyaksha, A.S., Chemistry Dept., Ferguson College, Poona 4.
 Rajan, V.D., Research Scholar, Engineering College, Benaras Hindu University
 Benaras.
 Rajagopalan, V.R., Dept. of Botany, Annamalai University, Annamalaiagar.
 Ramachandran, P.K., C/o. Head of the Dept. of Chemistry, Benaras Hindu
 University, Banaras.
 Raman, K., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Ramanmurti, M.V., C/o. Prof. S. S. Joshi, Head of the Chemistry Dept., Benaras
 Hindu University, Banaras.
 Ramkrishna, V., B.Sc., Dept. Applied Chemistry, Indian Institute of Science,
 Bangalore 3.
 Ramaiah, N.A., C/o. Dr. S. S. Joshi, Head of the Dept. of Chemistry, Benaras Hindu
 University, Banaras.
 Rajeswari, D., 20/10, Aswini Dutt Road, Calcutta 29.
 Rajendra, R., Bengal Veterinary College,
 Rakshit, Dilip Kumar,
 Rakshit, (Miss) Bithika,
 Rakshit, Usha, 3, Hemendra Sen Street, Calcutta.
 Rakshit, Birendra Kishore, 141/A/2-E, South Sinthi Road, Calcutta 2.
 Ramaswamy, Ramachandram, St. Paul's College, Cal.
 Ramalingam, K., Osmania University,
 Raman, K. Venkat, Benaras Hindu University,
 Ramswamy, Komala Glass, Rashbehary Avenue, Calcutta.
 Ramkrishnan, C. S., Indian Statistical Institute,

- Ramakrishnan, V., 72, Sardar Sankar Road, Calcutta 29.
 Ram, Swarup Ram, City College, Calcutta.
 Rasiah, T., St. Paul's College, Cal.
 Rathi, Premratan, Vidysagar College, Cal.
 Ratnam, P.V., C/o. Prof. S. S. Joshi, Head of the Chemistry Dept., Benaras Hindu University, Banaras.
 Ratnasapathy, A., St. Paul's College, Calcutta.
 Rahman, Matim,
 Razdan, R.K., C/o. Dr. P. C. Guha, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Rao, K. Sripad, Central Fisheries, Barrackpore.
 Rao, D. N., Banaras Hindu University, Botany Department.
 Rao, M. Kesava Rao, 73, Rash Behari Avenue, Calcutta.
 Rao, T. R. Govinda,
 Rao, B. G. Nagaraja,
 Rao, V. Kodanda Rama, Science College,
 Rao, B. Rameswar, 47, De Hostel, Banaras 5.
 Rao, D. R. Govinda, All India Institute Hygine & Public Health.
 Rao, K. Krishnamurti, All India Institute Hygine & Public Health.
 Rao, U. V. Malikhrailan, City College.
 Rao, G. M. Appa, C/o. Prof. S. S. Joshi, Head of the Dept. of Chemistry, Benaras Hindu University, Banaras.
 Rao, G.S., Krishna, Dept. of Organic Chemistry, Indian Insty, Indian Institute of Science Bangalore 3.
 Rao, S. Somasekara, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Ray, Dilip Kumar, 85, Rash Behari Avenue, Calcutta 26.
 Ray, Malayendra Nath, Geological Laboratory, Presidency College, Calcutta.
 Ray, Manilal, 142, Raja Rajendra Lal Mitra Road, Calcutta 10.
 Ray, Prem Sundar, Geological Laboratory, Presidency College, Calcutta.
 Ray, Siddhartha, 219-1, Lower Circular Road, Calcutta 17.
 Ray, Tajendra Kumar, Geological Laboratory, Presidency College, Calcutta.
 Ray, N., Science College, Calcutta.
 Ray, Debendranath Ray, Bangabasi College, Calcutta.
 Ray, J. N.,
 Ray, (Mrs) Manjuli,
 Ray, Binode Behari, Presidency College, Calcutta.
 Ray, Amita, Science College, Cal.
 Ray, Tejendra K., Presidency College, Cal.
 Ray, Puspa Ranjan, Calcutta Medical College, Cal.
 Ray, Lina, Scottish Church College, Cal.
 Ray, Iva, Scottish Church College, Cal.
 Ray, Pronabendra N., Presidency College, Cal.
 Ray, Bijnan, Science College, Cal.
 Ray, Manoj Lila,
 Ray, Asit, 3/1/C, Rani Sankari Lane, Calcutta 26.
 Ray, Dipak K., Presidency College, Calcutta.
 Ray, Sankarsan, 2, Haritaki Bagan Lane, Calcutta 6.
 Ray, Tarasankar, 11, Dr. Sarat Banerjee Road, Calcutta.
 Ray, Durgapada, Medical College, Cal.
 Ray, Arup Chandra, 56/2A, Gariahata Road, Flat 12, Calcutta 19.
 Ray, R. B., Patna Science College,

- Ray, Samarendra Nath, Scottish Church College, Cal.
 Ray, Uma Charan, Presidency College, Calcutta.
 Ray, Debabrata, Presidency College, Calcutta.
 Revata, Rev. K., Duff Hostel, Beadon Street, Calcutta 6.
 Rohatgi, H. K., 45, Armenien Street, Calcutta 1.
 Roy, Buttokeswar, 6th Year, Physiology, Science College, Calcutta.
 Roy, Chitra, 5th Year, Botany Science College, Calcutta.
 Roy, Sudhindra Ch., Presidency College,
 Roy, Amal K.,
 Roy, Rathindra Nath,
 Roy, Jyotsna Kumar, C/o. Dr. D. Chakravarti,
 Roy Choudhury, Asim, Medical College, Calcutta.
 Roy, Ranjit Mohan, 44-1A, Bancharam Akrur Lane,
 Roy, Mira, Botany Dept., Presidency College, Calcutta.
 Roy, Bhabani, Vidyasagar College, Calcutta.
 Roy, Mihir, Vidyasagar College, Calcutta.
 Roy, Dwijendranath, 1A, Maharani Swarnamoyee Road, Calcutta 9.
 Roy Chowdhury, (Mrs.) Mira,
 Roy, Lalit, 1A, Rajani Gupta Road, Calcutta.
 Roy Madan, R. G. Kar Medical College, Calcutta.
 Roy, Pankoj Narayan, Presidency College, Calcutta.
 Roy, Sudhindra Narayan, Presidency College, Calcutta.
 Roy, Anima, Presidency College, Calcutta.
 Roy, Bithika, Presidency College, Cal.
 Rou, Ashitranjan Guha, 107, Bosenagar, 24 Parganas.
 Roy Chaudhuri, Prosanta 8, Haralal Mitra Street, Calcutta 3.
 Roy, Nirmalendu, 50, North Chakraberia Road, Calcutta 20.
 Roy, Subhas Kanti, Eden Hindu Hostel, Calcutta 12.
 Roy, Chhaya, 238, Rashbehari Avenue, Calcutta 29.
 Roy, Subrata, Botany Dept., Presidency College, Calcutta.
 Roy, Sukesh Ch.
 Roy, Hemendra Sarkar, 2, Fern Place, Calcutta.
 Roy Chaudhuri, Arun Kumar,
 Roy, Mira, Botany Dept., Presidency College, Calcutta.
 Roy Arati, Botany Dept., Presidency College, Calcutta.
 Roy, Baby, Scottish Church College, Calcutta.
 Roy, Uma Basu, 32, Lake Temple Road,
 Roy Chaudhuri, Shyamapada, Presidency College,
 Roy, Subodh Kr. Botany Dept., Science College,
 Roy, Monoj, 46/3, Babu Bagan Lane, Calcutta 31.
 Roy Chowdhury, Arun K., Presidency College, Calcutta.
 Roy, Monoranjan, Presidency College, Calcutta.
 Roy, Ranen, Medical College, Calcutta.
 Roy Chowdhury, Sukumar, 86, J. K. Pal Road, Calcutta 38.
 Roy, Debabrata, Indian Statistical Institute, Calcutta.
 Roy, Sudhindranath, 102, Amherst Street, Calcutta 9.
 Roy, Mukul, 95, Russa Road, Calcutta 26.
 Roy Chowdhury, Sarma, 95, Russa Road, Calcutta 26.
 Roy, Ajit Kumar, Department of Psychology, Science College, Calcutta.
 Roy, A. C., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Roy, (Sm.) Aniali, Dept. of Education, University of Calcutta 95, Russa Road,
 Calcutta 26.

- Roy, Asoke Ranjan, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Roy, B.G., Dept. of Civil Engineering, B. E. College, Howrah.
 Roy, D., Dept. of Civil Engineering, B. E. College, Howrah.
 Roy, Dinesh Chandra, Deshbandhu Hostel, National Medical Institute, 32, Gorachand Road, Calcutta 14.
 Roy, (Sm.) Dolly, 46-2, Surendra Nath Banerjee Road, Calcutta 14.
 Roy, Haripada, Eden Hindu Hostel, 3, Peary Sarkar Street, Calcutta 12.
 Roy, Helen, 21A, Mohonlal Street, Calcutta.
 Roy, (Miss) Lina, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Roy, M.M., Dept. of Civil Engineering, B. E. College, Howrah.
 Roy, Madan, 24, Panchanantala Lane, Calcutta 12.
 Roy, Matilal, 67, Amherst Row, Calcutta 9.
 Roy Choudhury, (Sm.) Nilima, Dept. of Education, 95, Russa Road, Calcutta 26.
 Roy, Priyatosh, Eden Hindu Hostel, 3, Peary Sircar Street, Calcutta 12.
 Roy, Promod Ranjan, Eden Hindu Hostel, 3, Peary Sarkar Street, Calcutta 12.
 Roy, Purnendu, 9, Bright Street, Calcutta 19.
 Roy, Sailendra Nath, P-167K, Rash Behari Avenue, Calcutta 19.
 Roy, Siddhartha, 8-7-1B, Hatibagan Road, Block 1, Calcutta 14.
 Roy, Satishendra Nath, 101A, Vivekananda Road, Calcutta 6.
 Roy, Satya Sampad, Deshbandhu Hostel, National Medical Institute, 35, Gorachand Road, Calcutta 14.
 Roy, Surbit Kisor, 16-2R, Station Road, Calcutta 19.
 Roy Choudhury, Bimal, Dept. of Geology, Presidency College, Calcutta.
 Roy Choudhuri, Kamal, As above.
 Roy Choudhuri, N., Dept. of Civil Engineering, B. E. College, Howrah.
 Roy Barman, Sujit Kumar, 71, Pataldanga Street, Calcutta 9.
 Roy Chowdhury, Sukomal, 41-36F, Charu Avenue, Calcutta 33.
 Rohatgi, Chandra Krishna, 45, Armenian Street, Calcutta.
 Rohatgi, K. Sudha, 45, Armenian Street, Calcutta 1.
 Rohatgi (Miss) Manjula, as above.
 Rohatgi, (Miss) Mridula, as above.
 Rohatgi, Probhat Kumar, as above.
 Rudra, Siuli, C/o. Prof. M. N. Rudra, Darbhanga Medical College, Laheriasarai, North Bihar.
 Rudra, Amiya Gopal,

3

- Sabhrwal, Satish, Dept. of Pure Chemistry, 92, Upper Circular Road, Calcutta 12.
 Sangneria, Shyam S., 20, Tara Chand Dutt Street, Calcutta 1.
 Sarma, K. P., Patna Science College,
 Sahania, Ramesh Chandra, Cotton College, Gauhati.
 Salkia, Prafulla, Cotton College, Gauhati, Assam.
 Sanna, Rajen, R. G. Kar Medical College, Calcutta.
 Sarma, Depen, Cotton College, Assam.
 Sarkar, S., 14B, Gorachand Road, Calcutta 14.
 Sarkar, Manmatha R., 61/1E, Wellington Street, Calcutta.
 Sarkar, Tirthanath, Presidency College.
 Sarkar, Sushanta, Eden Hindu Hostel, Calcutta 12.
 Sarkar, Tushar K., 24, Southern Avenue, Cal. 26.
 Sarkar, Uma Sankar,

- Sarkar, Bimalendu, Calcutta Medical College, Calcutta.
- Sarkar, Amiya Kumar, 172-15E, Lower Circular Road, Calcutta 14.
- Sarkar, Biswa Ranjan, 8-1, Circular 6th Bye Lane, Santragachi P.O., Howrah.
- Sarkar, Gurudas Chandra, Eden Hindu Hostel, 3, Peary Sarkar Street, Calcutta 12.
- Sarkar, (Sm.) Lalita, 2, Lake Terrace, Calcutta 29.
- Sarkar, Pranabendu, 219/1, Lower Circular Road, Calcutta 17.
- Sarkar, Manindra Chandra, Zoological Laboratory, 35, Ballygunge Circular Road, Calcutta.
- Sarkar, R., Dept. of Civil Engineering, B. E. College, Howrah.
- Sarkar, Satyendranath, 29, Lansdown Place, Calcutta 29.
- Sarkar, Sudhir Kumar, Presidency College, Calcutta.
- Sarkar, Arun, Scottish Church College, Calcutta.
- Sarkar, Kalipada, 171, Bowbazar Street, Calcutta.
- Sarkar, Arun, Scottish Church College, Calcutta.
- Sarkar, Arun,
- Sarkar, Bhupati B., 123-2A, Amherst Street, Calcutta.
- Sarkar Premamoyee, 95, Russa Road, Calcutta 26.
- Sarkar, Anjali, Science College,
- Sarkar, Arati, Science College,
- Sarkar, Pabitra, Scottish Church College,
- Sarkar, Mahitosh, Vidyasagar College, Calcutta.
- Sarkar, Bhubaneswar, Vidyasagar College, Calcutta.
- Sarkar, Nirmalendu, Medical College, Calcutta.
- Shaha, Binoy Kumar, 105, Sovabazar Street, Calcutta 5.
- Saha, Ratna, Medical College, Cal.
- Saha, Prasenjit, Presidency College, Calcutta.
- Saha, Joshada Jivan, Bangabasi College.
- Saha, Joygopal, Presidency College, Cal.
- Saha, Birendranath, Motijhil, Dum Dum.
- Saha, Ganesh P., Bangabasi College,
- Saha, Anil K.,
- Saha, Arun Kumar, Geology Dept., Presidency College, Calcutta.
- Saha, Birendra Kishore, Bangabasi College, Calcutta.
- Saha, Nibaran, Medical Hostel, 29, Beniapukur Road, Entally, Calcutta.
- Saha, Ram Chandra, 25, Shova Bazar Street, Calcutta 5.
- Saha, Jyoti Ranjan, 11, Harrison Road, Calcutta.
- Saha, Santosh Ch., Presidency College,
- Saha, Kartik Ch., Calcutta National Medical Institute, Calcutta.
- Sahu, Monojit, College of Engineering & Tech., Cal.
- Sahu, Brojmoha, City College, Cal.
- Sahu, R. K.,
- Sahu, Amiya R., Medical College, Calcutta.
- Sarbadhikari, Timir Ranjan, 3A, Jamini Kaviraj Row, Calcutta 4.
- Sarda, D., Presidency College, Calcutta.
- Sanyal, Karuna P., Bangabasi College, Cal.
- Satyaban, Patnaik,
- Saha, Ramendra Lal, N. S. Med. College.
- Saha, Bhava Ranjan, 25, Scott Lane, Calcutta 9.
- Saharia, Labanya, Post Graduate, Calcutta University, Calcutta.
- Saha, Achinta Kumar, 3rd Year, Science, City College, Calcutta.
- Sarkar, Siddhantha, Bengal Veterinary College, Class 'A' Roll 34.
- Savapathy, A. R., Bengal Veterinary College, Class 'A', Roll 25.

- Sammuel, C., Bengal Veterinary College, Class 'A,' Roll 36.
- Sanyal, Dipankar,
- Saikia, Bhubendranath, Dept. of Physice, Cotton College, Assam.
- Sarmah, Probodh, Dept. of Physics, Cotton College, Assam.
- Sarma, Balaram, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
- Sarma, Pravat Chandra, Dept. of Physics, Cotton College, Assam.
- Sarma, Ratheswar, Dept. of Physics, Cotton College, Assam.
- Samaddar, Baidyarath, 323/1, Belilias Road, Howrah.
- Satnalika, Prayag Chand, Science College, Cal.
- Sarbajna, Bidash K., City College, Calcutta.
- Satapatty, S.N.,
- Sankaran, K.S.,
- Sahay, A.M., 9, Kaliprasanna Banerjee Road, Calcutta 6.
- Sanyal, Anupam, Presidency College, Calcutta.
- Saha, N., 14B, Gorachand Road, Calcutta 14.
- Sarbadhikary, Pradip R., 84, Ballyganj Place, Calcutta.
- Saraf, Srigopal City College Calcutta.
- Sasmal, Bivash Ch., Surendranath College, Calcutta.
- Sanh, B. R., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
- Sankaranarain, K. M., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
- Saraf, V. A., Chemistry Dept., Fergusson College, Poona 4.
- Sarbadhikary, (Sm.) Manjuri, Dept. of Education, 95, Russa Road, Calcutta 26.
- Sarkar, Sanat, Research Scholar, Botany Dept., Benares Hindu University, Benares.
- Sarangi, Bani K., 9, Bright Street, Calcutta 19.
- Saroff, Mahabirprasad, C/o. Sri Mahaborprasad Narasinghdas, 28, Cross Street, Calcutta 7.
- Satyanarayan, Y., C/o. Shri F. R. Bharucha, Institute of Science, Fort, Bombay 2.
- Saxena, A. P., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
- Saxena, M. S. Lal, Dept. of Psychology, Benares Hindu University, Benares.
- Saxena, Premnath, C/o. Dr. Satya Prakash, Secretary, Scientific Research Committee, Allahabad, U. P.,
- Sayied, Abul Maksud, 4, Ram Sankar Roy Lane, Calcutta 14.
- Sen Gupta, Nira, 5, Raghu Nath Chatterjee Street, Calcutta.
- Sen Gupta, Priyaranjan, 22/C, Ranendra Mitra Lane, Calcutta 4.
- Sen, Rabindranath, 11A, Mohan Bagan Lane, Calcutta 4.
- Sen, Sumitra, 49B, Sankaripara Road, Calcutta 25.
- Sen, Gouri, 7B, Ekdalia Road, Calcutta 19.
- Sen, Prabhat Kr., Gobinda Niketan, Jogen Sen Road, Chandarnagore.
- Sen Gupta, Sujit K., 1A, Maharani Swarnamoyee Road, Calcutta.
- Sen, Aparna, 54/4/D, Hazra Road, Calcutta 19.
- Sen, Jharan, Presidency College, Cal.
- Sen, Sisir, Presidency College, Cal.
- Sen, Dillip Kumar,
- Sen, Kanita, Science College, Cal.
- Sen Gupta, Bhabaranjan, Medical College, Cal.
- Sen Gupta, Sisir Kumar, Presidency College, Calcutta.
- Sen Gupta, Santi, Bangabasi College,
- Sen Gupta, Hrishikesh, 3B, St. James Square, Calcutta 12.
- Sen, (Miss) Priti, C/o. S. J. Santi Sen, 8, Adhar Chandra Das Lane, Calcutta 4.
- Sen, (Miss) Archana, 1, Crwokéd Lane, Calcutta 1.
- Sen, Ahim K., 112, Lower Circular Road, Calcutta 14.

- Sen, Debiprasad, 35, Scott Lane, Calcutta.
 Sen, Minati, City College, Calcutta.
 Sen Gupta, Anjali,
 Sen, AnilK., Radio Physics,
 Sen Gupta, Hrishikesh, 3B, St. James Square, Calcutta 12.
 Sen Gupta, Sadhan K., Bangabashi College, Calcutta.
 Sen, Mira, 21F, Deshapriya Park Rd., Calcutta 26.
 Sen Gupta, Santi Ranjan, Bangabashi College, Cal.
 Sen Gupta, Debabrata, Presidency College, Calcutta.
 Sen, Krishen, City College,
 Sen Gupta, Ajoy Kumar, 6th Year, Applied Math., Roll 15.
 Sen, Chitra,
 Sen, Subir, P.O. Talpukur, Barrakpur.
 Sen, Neoti, Presidency College, Calcutta.
 Sen, Bhuvananda Sen, Medical College, Calcutta.
 Sen, Anil K., Medical College, Calcutta.
 Sen, Vedaprāsad, Presidancy College, Cal.
 Sen Gupta, Parimal, Presidency College, Cal.
 Sen, Shampasri, Ashutosh College, Calcutta.
 Sen, Sunil, 10-1B, Nepal Bhattacharyya Street, Calcutta.
 Sen, (Sm.) Arati, C/o. Principal, Basic Training College, Banipur.
 Sen, Hiten Kumar, 34-D, Keshab Chandra Sen Street, Calcutta 9.
 Sen, (Miss) Jharna, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Sen, Karunamoy, 122-1A, Maniktala Street, Calcutta 6.
 Sen, (Miss) Manasi, C/o. Prof, S. K. Bose, Psychology Laboratory, 92, Upper Circular Road, Calcutta 9.
 Sen, Milan Kumar, 37-5, Russa Road, Calcutta.
 Sen, Pranab, C/o. Prof. S. K. Bose, Psychology Laboratory, 92, Upper Circular Road Calcutta 9.
 Sen, Purnendu, Geology, Dept. Presidency College, Calcutta.
 Sen, Ram Lochan, Dept. of Psychology, 92, Upper Circular Road, Calcutta 9.
 Sen, (Miss) Rama, Dept. of Psychology, as above.
 Sen, Ram Utpal, Dept. of Psychology, as above.
 Sen, (Sm.) Sabita, 16-G, Dover Lane, Calcutta 29.
 Sen, Samir Kumar, Student of Chemical Engineering, 24A, Garpar Road, Calcutta 9.
 Sen, Sankar, Geological Laboratory, Presidency College, Calcutta.
 Sen, Subrata, 19B, Sadananda Road, Top Floor, Calcutta 26.
 Sen, (Sm.) Sujata, 171, Lower Circular Road, Calcutta 14.
 Sen, Debabrata, Dept. of Pure Chemistry, 93, Upper Circular Road, Calcutta
 Sen, Arati, 95, Russa Road, Calcutta.
 Sen, N. N., Medical College, Calcutta.
 Sengupta, Debyendru, Surendranath College, Calcutta.
 Sengupta, Jauanta K., Presidency College, Calcutta.
 Sen-Gupta, Himansu,
 Sen-Gupta, Dilip,
 Sengupta, Kalyan, Presidency College,
 Sen, Dilip, 42/6, Tel Kall Ghat Rly. Colony, Howrah.
 Sen Gupta, (Sm.) Geeta, 21A, Raja Bagan Lane, Dum Dum, Calcutta 30.
 Sen Gupta, (Sm.) Annapurna, Dept. of Education, 95, Russa Road, Calcutta 26.
 Sen Gupta, (Miss) Bani, 2-1D, Townshed Road, Calcutta 25.
 Sen Gupta, Barun, 14, Balai Sinha Lane, Calcutta 9.
 Sen Gupta Barun Kumar, Dept. of Geology, Presidency College, Calcutta 14.

- Sen Gupta, (Miss) Ila, 175-1, Upper Circular Road, Calcutta 4.
 Sen Gupta, (Miss) Jasodhara, 2, Bepin Pal Road, Calcutta 26.
 Sen Gupta, (Miss) Juthika, 6, Satyen Dutta Lane, Calcutta 29.
 Sen Gupta, Mihir, 2D, Nayan Krishna Saha Lane, Calcutta 3.
 Sen Gupta, Mihir Kumar, 146, Ambagan Road, Sakchi, Jamshedpur.
 Sen Gupta, Paritosh, College Hostel, 19, Station Road, Calcutta 31.
 Sen Gupta, Supriya Mohan, Dept. of Geology, Presidency College, Calcutta.
 Sengupta, Ramendranath, Science College,
 Sengupta, Shishutosh, 124D, Russa Road, Calcutta.
 Senadhura, Sreehala, Roll 7, Sec. 1, Year II, Law College, Calcutta.
 Seshpande, S. D., Central Fisheries, Barrackpur.
 Seth, Satyenjit, Presidency College, Cal.
 Seth, Satyenjit, Presidency College, Cal.
 Seth, Dinesh Ch., Vidyasagar College,
 Seshadri, K. R., C/o. Head of the Dept. of Chemistry, Benaras Hindu University,
 Benares.
 Sett, Debkumar, 3, Sir, Hariram Goenka Street, Calcutta 7.
 Seal, Dwijendra Prasad, Student, Diploma 3rd Year, 2, Cornwallis Street, Calcutta.
 Seal, Kamalesh, Medical Hostel, 29, Beniapukur Road, Calcutta.
 Seal, (Miss) Shova, 35, Parasar Road, Calcutta 29.
 Senapati, Gobinda, Canning Hostel, 35, Scot Lane, Calcutta 9.
 Sha, Debashis, Calcutta Medical College, Cal.
 Shankar, J.V., C/o. Sri, F. R. Bharucha, Institute of Science Fort, Bombay 1.
 Sharma, J.V.S., C/o. Prof. S. S. Josh, Head of the Dept. of Chemistry, Benares Hindu
 University, Benares.
 Sharma, R.A., C/o. as above.
 Shyam, Prasanta Kumar, Eden Hindu Hostel, Calcutta 12.
 Sharma, R.C., Research Scholar, Chemistry Dept. Lucknow.
 Shukla, B.M., C/o. Prof. S. S. Josh, Benares Hindu University, Benares.
 Sharma, Nandalal, Vidyasagar College, Cal.
 Sharaf, K. K., City College, Calcutta.
 Shah, Bhogilal, 4/A/2, Roxy Chambers, Chowringhee, Calcutta.
 Shrestha, Jogendranath Bhakta, Botany Dept., Presidency College, Calcutta.
 Shrestha, Jogendranath Bhakta, Botany Dept., Presidency College, Calcutta.
 Shome, Murari Mohan,
 Shelolika, B.S., 45-1A, Amherst Street, Calcutta 9.
 Shah, Bodh N., Bangabasi College, Cal.
 Shaw, Hari, Bangabasi College, Calcutta.
 Shamy, R. Krishna, All India Institute of Hygiene & Public Health.
 Shukla, Biswanath, City College,
 Shethia, A. S. R., City College, Calcutta.
 Shah, Chaya, Calcutta University, Calcutta.
 Shaha, Jyotish Ranjan, Calcutta National Medical Institute, 3, Gora Chand Road,
 Calcutta.
 Shaw, Hiralal, Scottish College,
 Siddhanta, N. N. S., C/o. Head of the Chemistry Dept., Benares Hindu University,
 Benares.
 Sikdar, Triuli, Geology Dept., Presidency College, Calcutta.
 Sil, Sudhir, Ranjan, 171, Lower Circular Road, Calcutta 14.
 Sinha, Krishna Kumar, Room No. 5, 105, Harrison Road, Calcutta.
 Sinha, Ranen, Zoological Laboratory, 35, Ballygunge Circular Road, Calcutta 19.
 Sinha, Sanjit Kumar, Eden Hindu Hostel, 3, Peary Sarkar Street, Calcutta 12.

- Singh, A. Jogeswar, Eden Hindu Hostel, as above.
 Singh, Ganga, Dept. of Geography, Calcutta University, Calcutta 12.
 Singh, Kartar, University of Delhi, Delhi.
 Singh, Ranbir, C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
 Singha, A. P. B., Research Scholar, Chemistry Dept., Science College, Patna.
 Sircar, Geeta, Presidency College, Calcutta.
 Sinha, Bichihananda, Science College,
 Sikhder, Pradoyat K., City College, Calcutta.
 Simbi, Nani Gopal, Presidency College, Hostel,
 Singh, B. U., I.C.A.R., Delhi.
 Singh, Nabaprasad, City College, Calcutta.
 Singh, Kamala Prasad, 117, De Hostel, Banaras.
 Singh, Monomohan,
 Singh, Gurumukh,
 Singh, Jagadish Narayan, City College, Cal.
 Singh, K. I., St. Paul's College, Calcutta.
 Singh, D. M., Patna Science College.
 Singh, Dhrubdeo Narayan, Bangabasi College, Calcutta.
 Singh, Harnaarinder, 45-1A, Amherst Street, Calcutta 9.
 Singha, Bimal Kumar, 3rd Year, Physiology (Hons.), Science College, Calcutta.
 Sinha, Asoke Kr., Cupar Road, Konnagar, Hooghly.
 Sinha, Sachiprosad, Science College, Calcutta.
 Sinha, Abani Kumar,
 Sinha, Sunil, Presidency College, Calcutta.
 Sinha, Dipak, Presidency College, Cal.
 Sinha, Monimohon, 52B, Kansaripara Road, Calcutta.
 Sinha, Sukriti, Presidency College, Cal.
 Sinha, Sailen, Calcutta National Medical College, Calcutta.
 Sinha, Rajnondon, Bangabasi College, Calcutta.
 Sirkar, Arun Kumar, 38-W, The Park, Ishapur, P. O., 24-Parganas.
 Sivalinghann, V., Bengal Veterinary College,
 Singh, Keshawa Prosad, City College,
 Singha, Dev Kumar, College of Aeronautical Survey, Dum Dum.
 Sinha, Pratul Chandra,
 Sinjha, Arabindu, 32, Russa Road, Calcutta 11.
 Siddhanta, Salil Kr., Presidency College, Calcutta.
 Singh, K. N., St. Paul's College, Cal.
 Singh H. Devandra, Presidency College, Cal.
 Sihi, Kunersh, University, Math. Dept.
 Sikdar, Krishna K.,
 Singha, Kabita, Botany Dept., Presidency College, Calcutta.
 Sorana, Noratan Mall, Presidency College, Cal.
 Soni, Ram Chand, Presidency College, Cal.
 Sothianathan, St. Paul's College,
 Som, Panchanon, 5, Tibbati Baba Lane, Chakrabaria, Howrah.
 Somayajuly, G. R., C/o Prof. S. S. Joshi, Benares Hindu University, Benaras.
 Sourirajan, S., Dept. of Applied Chemistry, Indian Institute of Science, Bangalore.
 Srikantiah, H., Food Technology Laboratory, Indian Institute of Science, Bangalore.
 Srivastava, R. D., Dept. of Chemistry, Lucknow University, Lucknow.
 Srikanthan, K. S., 20, Gorachand Road, Calcutta 14.
 Srinivasan, V., National Lodge, Rashbehary Avenue, Calcutta 29.

- Srimany, Sudhir Kumar, Department of Chemistry, Science College, Calcutta.
 Students of Lady Brabourne College, (12 students).
 Sulochona, (Miss) D., Science College, Calcutta.
 Sundaram, P. M., 88A, Jatin Das Road, Calcutta 29.
 Sundarajan, T. V., 53, Jatindas Road,
 Sutradhar, M. G..
 Subbayya, L.C., Kamala Vilas, Calcutta 26.
 Sur, Siba Prasad, 45/IA, Amherst Street, Calcutta 9.
 Surapati, Samir Kumar,
 Surasundaram, S., St. Paul's College, Calcutta.
 Subramanian, T. A.,
 Sushila, S., Ashutosh College, Calcutta.
 Subramanian, A. R., Duff Hostel, Beadon Street, Calcutta 6.
 Subrahmanyam, N., C/o. Head of the Dept. of Chemistry, Benares Hindu University,
 Benares.
 Subbalakshmi, (Miss) P. V., C/o. as above.
 Sundaram, P. S., Y. M. C. A., 138, Keshab Sen Street, Calcutta 9.
 Sur, S. N., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore 3.
 Sural, Debaprasad, 216, Vivekananda Road, Calcutta 6.
 Syam, Pravas Chandra, 219/1, Lower Circular Road, Calcutta 17.

T

- Talukder, Shyam Binode, City College, Calcutta.
 Talukdar, Ranjit, Science College, Calcutta.
 Talpasy, Sesha, Rech. Scholar, Botany Dept., Benares Hindu University, Benares.
 Talukdar, (Miss) Amita, 3, Albert Road, Calcutta 16.
 Talukdar, Balaram, 10, Rowdon Street, Calcutta.
 Talikdar, (Sm.) Sumitra, 3, Albert Road, Calcutta 16.
 Tandon, R. K., House Master, Hostel No. 1, Central Hindu School Hostel, Kamachha,
 Benares.
 Tankha, V. N., University of Delhi, Delhi.
 Tewari, B. K., C/o. Head of the Dept. of Chemistry, Benares Hindu University,
 Benares.
 Tewari, Ramji, 117, De Hostel Banaras.
 Thakur, (Miss) V. N.
 Thakurta, D., Dept. of Civil Engineering, B. E. College, Howrah.
 Thambi, M. V., Chemistry Laboratory, Loyola College, Madras 6.
 Tharad, Bholanath, City College, Calcutta.
 Thakur, Shyamal Kishore, City College,
 Tibrawal, Sami Chand, St. Paul's College, Calcutta.
 Tikoo, P. K., C/o. Head of the Dept. of Chemistry, Benares Hindu University,
 Benares.
 Tikadar, Benoy Krishna, Zoological Laboratory, 35, Ballygunge Circular Road,
 Calcutta.

U

- Ukil, Prodesch Ch. 53, Jatin Das Road, Calcutta 29.
 Upadhyaya, A., C/o. Head of the Dept. of Chemistry, Benares Hindu University,
 Benares.
 Upadhyaya, Umakant, Geological Laboratory, Presidency College, Calcutta.

V

- Varma, B. P., Patna Science College,
- Venkatesh, K., Central Fisheries, Barrackpur.
- Venkataraman, D.,
- Vedantan, V., Indian Association for the Cultivation of Science,
- Venkatrama, M. V., Velvediar House, Alipore, Calcutta 27.
- Venkataraman, T.S.,
- Venkataraman, N., Dept. of Applied Chemistry, Indian Institute of Science, Bangalore.
- Venkitasubramaniam, T. A. Food Technology Laboratory, Indian Institute of Science, Bangalore 3.
- Venkatesan, K. R., Post-graduate Student in Botany, Annamalai University, Annamalaiagar.
- Vidwana, D. H., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Baneres.
- Visvanathan, P. S., The Institute of Science, Mayo Road, Fort, Bombay.
- Viswanathan, K. V., Department of Organic Chemistry, Indian Institute of Science, Bangalore 3.
- Viswanathan, K. S., C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.
- Viswanathan, K. V., Dept. of Organic Chemistry, Indian Institute of Science, 120 Bangalore 3.

X

- Xavier, J, C/o. Head of the Dept. of Chemistry, Benares Hindu University, Benares.

Y

- Yadava, Bhupendra Narayan, Bangabasi College, Calcutta.

Z

- Zakia, 13, Lower Range, Calcutta 17.

INDEX

INDEX TO PARTS I, II, III

A

- Acharya K. T. and S. A. Saletore. The Preparation of ricinoleic and oleic acids by simple techniques. III, 105.
- Acharya K. T., S. Venkob Rao and S. A. Saletore. Chlorination of Ricinoleic acid its Methyl ester. III, 104.
- Address of the General President: Science and our Problems—Dr. J. N. Mukherjee. II, 1.
- Adiseshiah, William, Immediate recall and presentational stress, III, 285.
- Adiseshiah, William, The perceptual efficacy of serial material, III, 286.
- Agarwal H. P. and K. S. G. Doss. Determination of the Value of 'E' of absolute reaction rates, for the quinhydrone system. III, 78.
- Agarwala, S. B. D., Preliminary experiments on the control of *Calcutta Oryzae*. Linn (rice weevil) infesting wheat at Pusa (North Bihar) 1949, III, 308.
- Agarwala, S. D. and S. Z. Haidar, *Precis orithya* as a controlling agent for *Striga euphrasioides*; a root parasitic weed on sugarcane, III, 306.
- Aggarwal R. C. and M. R. Nayar. Studies on Transport Number. System:—Brium nitrate—alkali nitrate—water. III, 71.
- Aggarwala, S. D., On the control of paddy hispa, III, 206.
- Agharkar, S. P. and B. A. Razi. Some aspects of the embryology of *Lawia zeylanica* and *Zeylanidium olivaceum*, III, 22.
- Agarwal, Y. K. and M. S. Sadashiviah. A Note on the Idiomorphic Felspar Crystals from the Pegmatite of Charkhi Mine, Kodrama Micafield. III, 168.
- Agricultural Sciences: Research and Development Function Vis-a-Vis The Needs of the Sugar Industry—K. L. Khanna. II, 197.
- Ahmad, Aiyid Shamim, M. Omar Farooq and Mohd. Sharif. Methyi Amine-Acetaldehyde Complex. III, 163 & 164.
- Ahmed, B. A. Gulam. Mitochondria in the a-normal hepatic cells of *Ichthyophis glutsionsus* (Linn.) and *Uraeotyphlus narayani* (Seshachar), III, 336.
- Ahmad S. Shamim and M. A. Wajid. Resonating Semipolar Single Bond Part VIII. Hyperconjugation, Strength of Acids and Calculation of Dipole Moments, III, 166.
- Ahmad Saiyid Shamim and Hamadul Hassan. Resonating Semipolar Single Bond Part VII Reactions of the Double Bond (Olefines), III, 165.
- Ahmad Saiyid Shamim and Kh. M. A. Aziz. Resonating Semipolar single Bond Part Division of Reactions into one Electron and Two Electrons Transfer Types, III, 163 & 164.
- Ahmad Shamim S. and Hameedul Hasan. Resonating Semipolar Single Bond Part VI Molecular Rearrangements, III, 165.
- Allam, S. Mashhood. Skeleto-muscular mechanism of the external female genitalia of a *Broconil* wasp, III, 320.
- Amma, Miss. K. Pankajakshi, Preparation of Insecticides and Fungicides from low grade shark liver oil, III, 140.
- Amma T. Pankajakshi and P. Saradamma. Synthesis of Anthocyanidin Pigments, III, 111.
- Anthropology and Archaeology: The Racial Problem of Bengal—Tarak Chandra Raychaudhuri. II, 169.
- Annual Report of the Indian Science Congress Association 1951. I, 32.

- Anjaneyulu, B. J. N. S. R., C. Mahadevan, and Y. Bala Sankaram. Black Sand Concentrates along the beach in South Visakhapatnam District, III, 171.
- Apparao G. M., N. Subrahmanyam and J. V. Sarma. Behaviour of H₂ (1—40 mm.) under Tesla excitation, III, 58.
- Apparao, G. M., N. Subrahmanyam and J. V. Sarma. Production of Joshi Effect in I₂ Vapour under H. F. Excitation, III, 220.
- Apparao, G. M., N. Subrahmanyam and J. V. Sarma. Studies of Joshi effect in I₂ Vapour under H. F. Excitation, III, 58.
- Arnikar, H. J. The Joshi Effect over the Range of the Falling V-i Characteristic, III, 215.
- Arnikar, H. J. The Joshi Effect over the Range of the Falling V-i Characteristic, III, 215.
- Arnikar, H. J. The 'Corona Pressure' Effect in Air. Action of Repeated Discharges III, 215.
- Arnikar, H. J. The Joshi Effect in the Positive Ion Current in Air under X-rays, III, 225.
- Arrangement for the Thirty-Ninth Session. I, 17.
- Asolkar, G. V. Studies in Joshi Effect in Air-organic Vapour Mixture at Atmospheric Pressure under X-Rays, III, 73.
- Asolkar, G. V., M. R. Bhiday and V. G. Bhide, Magnetic Analogue of Joshi-Effect, III, 223.
- Aswathanarayana, U. Studies on some Radioactive Minerals from South India, III, 169.
- Aswathanarayana, U. and C. Mahadevan. Distribution of Radioactivity at different levels from K. G. F. Mines, III, 172.
- Aziz Kh. M. A. and Saiyid Shamim Ahmad. Resonating Semipolar single Bond Part Division of Reactions into one Electron and two Electrons Transfer Typer, III, 163 & 164.

B

- Badami Rajashekar C. Chemical Examination of the Bark of *Holoptelea Integrifolia*, III, 115.
- Bagchi, D. N. and S. N. Banerjee, Some observations on tests designed to assess functional efficiency of circulatory and respiratory system and general fitness, III, 253.
- Bagchi, K. The Polavaram Project—A plea for its Revision, III, 186.
- Bagchi K. N. and G. C. Esh. Nutritional Survey on Available Food Materials Part II. The effect of parboiling, milling and storage on the nutritive value of Rice, III, 116.
- Bagchi, K. N. and S. K. Basu. Chemical composition of saps of Palm Trees, III, 191.
- Bagchi K. N. and G. C. Esh. Nutritional Survey on Available Food Materials. Part I. Wheat, Flour, Atta and Millets, III, 116.
- Bahl, A. N., N. D. Kehar and P. C. Sawhney, Studies on protein, calcium and phosphorus metabolism in growing lambs, III, 266.
- Bahl, A. N., N. D. Kehar and P. C. Sawhney, Blood studies in lambs on different levels of protein intake, III, 265.
- Bal D. V. and F. S. Khambata, Four new species of the genus *Acanthobothrium* from Marine Fishes of Bombay. III, 316.
- Bal, S. N. and B. Gupta, Pharmacognosy of Indian Ephedras. III, 19.
- Balakrishnan, S. and S. S. De. Effects of levels of fat and protein on the intestinal synthesis of thiamine in rats. III, 259.
- Balasubramanian, S. C., M. Ramchandran, T. Viswanathan and S. S. De, Amino-acid composition of Indian food-stuffs, III, 261.

- Ballabh, Ram. On two-dimensional superposable flows, III, 10.
- Bami H. L. and M. S. Chadha, Biguanides as Potential Antimalarials, III, 113.
- Bandyopadhyay, Debabrata and Priyada Ranjan Ray. Stability of chromium (III) Biguanide and Chromium (III) Phenylbiguanide complexes, III, 50.
- Bandyopadhyay, G., Note on the possibility of Polytropic Stars with power law for opacity and sub-atomic Energy Generation, III, 10.
- Bandyopadhyay, K. S., K. Sharma and K. L. Khanna, On the classification of wheat samples, III, 289.
- Bandyopadhyay, K. S., K. L. Khanna and S. C. Sen, On the prediction of Sugar Recovery, III, 289.
- Banerjee, A. K. and D. Panja. Intanitle allergy in relation to scabies. III, 203.
- Banerjee, A. K. and D. Panja. Treatment of Alopecia areata by intradermal in jection of Milk and Methyl Acetyl Choline, III, 203.
- Banerjee, A. K. and D. Panja. Nocardiosis of the skin and subcutaneous tissue in Bengal, III, 204.
- Banerjee, B., Investigations on the nutritional level of the students and nurses of Assam Medical College, III, 262.
- Banerjee, B., Studies on the basal metabolic rate and its variation amongst the Assam Medical College students and nurses during the winter season, III, 254.
- Banerjee, B., Haematological studies in students and nurses of Assam Medical College, III, 253.
- Banerji, D. P., On the Cesaro Summability of Fourier's Series. III, 2.
- Banerji, I. The organization of the shoot apex in *Asparagls recemosus* Willd, and *Agave mexirana* Lam, III, 29.
- Banerjee J. C., Atma Ram, S. B. Roy and Y. P. Varshney, Studies on Indian Talcs Part I. General Chemical and Mineralogical Characteristics, III, 126.
- Bandari, L. C., New Horizons in Clinical Psychology. III, 280.
- Banerjee, N. R., V. D. Krishnaswami and K. V. Sundarajan. The Microlithic Industry of Tinnevely, III, 45.
- Banerji R. B. On the Oripin of the Third Ionospheric Echo. III, 64.
- Banerji, R. B. On the Origin of the Third Ionospheric Echo. III, 64.
- Banerjee, Ramendra Nath, Refrigeration in Market Milk Industry, III, 234.
- Banerjee, S. and H. P. Chattopadhyay, Effect of germination on the niological value of proteins of pulses, III, 262.
- Banerjee, S. and C. Deb. Blood change sin scurvy, III, 260.
- Banerjee, S. and H. P. Chattopadhyay, Effect of germination on the vitamin E content of pulses, III, 260.
- Banerji, S. and N. C. Ghosh, Biosynthesis of nicotinic acid in germinated pulses, III, 259.
- Banerjee, Sachidananda and Haripada Chattopadhyay, Studies on the Ascorbic Oxidase Activity of some Common Indian Pulses during germination, III, 271.
- Banerji, Sudhir Kumar and Girija Prosanna Majumdar. The origin and develop- ment of the shoot apex in *Lycopodium phlegmaria*, L., III, 40.
- Banerji, Sudhir Kumar and Girija Prosanna Mazumdar. The origin and develop- ment of the shoot apex in *Equisitum debile*. Roxb., III, 39.
- Banerjee, S. L., S. K. Guha and Gurdas Ram. A Preliminary Vibration on the Khadawasla dam (Poona, India), III, 252.
- Banerjee, S. M. and R. N. Sen, Cuttach climate and comport, III, 253.
- Banerjee, S. M. and U. N. Dash, Study of normal bone marrow cytology in Orissa, III, 253.

- Banerjee, S. N. and D. N. Bagchi, Some observations on tests designed to assess functional efficiency of circulatory and respiratory and general fitness, III, 253.
- Banerjee, S. N. and S. K. Siddhanta. Complex Compounds of N-Acetyl Thiourea with Mercuric Ion, III, 48.
- Banerjee, S. S., M. Sengupta and G. G. Mukherjee, Effect of Undulations in the inosphere on the fading patterns, III, 252.
- Banerjee, S. S., R. R. Mehrotra and V. D. Rajan, Long distance Scattering of radio waves and undulations in the ionosphere, III, 251.
- Baruas, (Miss) S., Miss C. Das Gupta and P. Nandi. Selection of better strains of *Aspergillus niger* for the production of citric acid from sugars, III, 34.
- Basak G. C. and N. C. Niyogi. A study of the Fischer-Tropsch synthesis:—Part II. Efficiency of the synthesis Process using Co-catalyst, III, 134.
- Basu, B. C., P. Balarama Menon and C. M. Sengupta Cases of myiasis in man due to *Oestrus ovis* Linnaeus, (sheep bot), III, 322.
- Basu, B. C., P. Balarama Menon and C. M. Sengupta, Distribution of *Tabanus* flies in India and the adjacent countries, III, 323.
- Basu, B. C., P. Balarama Menon and C. M. Sengupta, Studies on the bionomics of *Tabanus* flies in the field with a view to work out control measures, III, 322.
- Basu, N. M., On some Figurate Numbers and Associated Generating Functions. III, 6.
- Basu, P., N. K. Chakraborty and P. Nandi, Antibiotic activities of some micro organisms isolated from Bengal, III, 38.
- Basu, P., S. B. Chattopadhyay, S. K. Sen Gupta, N. P. Das. Observations on the incidence of stem rot of jute caused by *Macrophomina phaseoli* (Maubl.) Ashbv, III, 36.
- Basu, S. K. and K. N. Bagchi. Chemical composition of saps of Palm Trees. III, 191.
- Basu, S. K. On comparison of the total strength of some Hausdorff Matrices. III, 8.
- Basu, S. P., Effect of different surface area on the survival and transyort of larvae of major Indian Carps. III, 334.
- Basu, S. P., Effect of different concentrations of H_2S (Sulphuretted Hydrogen) on the Oxygen consumption and survival of fingerlings of major Indian Carps, III, 327.
- Basu, U. P., M. Sen Gupta and N. De Sircar. On the quality of groundnut oil. III, 302.
- Basu U. P. and Sukhmoy Bhattacharya. Studies on Vitamin A in Solution: Aqueous System. III, 102.
- Baydekar P. R. B. R. Walavalkar and R. P. Daroga. Rate of Settling of Commercial Lime Suspensions. Part I. Effect of the Amount of Water Used for Hydration. III, 147.
- Baydekar P. R., B. R. Walavalkar and R. P. Daroga. Rate of Settling of Commercial Lime Suspensions. Part III. Effect of Particle Size of Lime. III, 148.
- Behura, B. K. and G. C. Sengupta, Annotated list of corp pests in the state of Orissa, III, 308.
- Belavadi (Miss) B. and M. C. Nath. Studies on the Biosynthesis of Vitamin C and a probable precursor. III, 120.
- Bhalerao, V. R. and M. Srinivasan, Fortification and Colourisation of Vanaspathi with Carotene derived from Vegetable sources. III, 273.
- Bhalerao, V. R., M. Srinivasan and N. Subramanian, Investigations on some little known indigenous Edible Plant Materials as possible sources of Food supplements, III, 274.

- Bhandari, K. G. Studies on the glands of the Head Capsule of Red Pumpkin Beetle (*Autocophora foveicollis* Lucas) Fam. Chrysomelidae, III, 321.
- Bhandari, P. K. and S. K. Bhattacharyya. Studies on the Iodination of Ricinoleic Acid in the Dark in different non-polar Solvents, III, 66.
- Bhardwai, D. C. On some interesting Jurassic woods from Rajmahal Hills, Bihar, III, 31.
- Bhargava, D. N. and K. P. Shukla. Estimation of Seepage Losses in Earthen Channals with a Sloop Fill, III, 246.
- Bhargava, P. M. and S. Husain Zaheer. Condensation of Chloroacetone with Phenol and its Ethers, III, 104.
- Bhargava, Prithwi Nath. 2-Arylimino-3 aryl-4 Ketotetrahydrothiazoles, III, 113.
- Bhaskaran, R., D. K. Ray, G. A. Shivani, Miss. M. Oommen. A study on some Coccidra of Himalayan birds, III, 314.
- Bhaskaran, T. R., K. Subrahmanyan and M. A. Sampathkumaran. Observations on the Survival of Ova of Intestinal Parasites in some Sewage Treatment Plants Around Calcutta, III, 117.
- Bhaskaran, T. R., G. K. Seth and K. Subrahmanyan. Effect of treatment with chemicals on the settling efficiency of lac wastes, III, 127.
- Bhaskaran T. R. and M. A. Sampathkumaran. Studies on Algal Photosynthesis in Relation to Oxygenation of Water, III, 117.
- Bhat, M. D. Analysis of G.R. Forms, III, 17.
- Bhata, Miss Bimla. Adaptive modifications in a Hillstream catfish, *Glyptothorax telchitta* (Hamilton), III, 332.
- Bhatia, Baldev Singh, Magina Lal Jain, and Girdhari Lal. Canning of curried vegetables, III, 302.
- Bhatia, M. L., and K. H. Mann. *Haemopsis sanguisuga* Linnaeus, the common European Arhynchobdellid Leech compared with *Haemopsis indicus* Bhatia. Indian form of Kashmir, III, 317.
- Bhatt, N. M. Sextiles and octiles with the ordinates at these quantiles in Pearson's Type III Curve., III, 14.
- Bhattacharya, A. K. and N. R. Subbaratnam. Studies in the kinetics of Iodination of Hydroxylamine, III, 76.
- Bhattacharya A. K. and K. V. Narayan Rao. Studies in Acetone Iodine Reaction, III, 76.
- Bhattacharya Anil. On an Alkaloid of *Kopsia fruticosa* Studies on Some Degradation Products, III, 99.
- Bhattacharya, A. P. On the periodicity of floods in the Ganga River at Raiwala near Hardwar, III, 15.
- Bhattacharya, A. P. Effects of Pumping of Tube Wells in Deabs east of the Ganga River in Western U. P., III, 15.
- Bhattacharya, G. and P. Sen. Redox Potential of Alloxan and its Physiological Action, III, 275.
- Bhattacharya, G. and P. B. Sen. Reversal of the Diabetogenic Action of Alloxan by Sulfhydryl Compound, III, 275.
- Bhattacharya, G. C. and P. C. Sinha. Quinoline Complexes of Cobalt and Nickel Sulphates and their Heats of Formulation, III, 54.
- Bhattacharya, P., S. S. Prabhus and S. N. Chatterjee. Gestation periods of Indian Breeds of Cattle II, III, 195.
- Bhattacharya, P. and S. N. Luktuke. Studies on reducing substances of Semen. Fructolysis in Bull Semen and relation of Sperm concentration to Fructose content, Semen volume and fructolysis, III, 264.

- Bhattacharya, P., D. P. Mukherjee, S. S. Jawa, Seasonal Variation in the Rate of Respiration, Pulse Rate and Body Temperature of different age groups of Hariana Cattle, III, 265.
- Bhattacharyya, P., S. S. Prabhu and S. N. Chatterjee, Secondary "Sex ratio" of normal births in Indian Cattle—II, III, 196.
- Bhattacharyya, P., D. P. Mukherjee, and M. P. Johari, Effect of the Intra Vaginal Administration of the Gel Mass of Rabbit Semen on the Reproductive organs of the Female Rabbit, III, 265.
- Bhattacharya, P. and S. N. Luktuke, Effect of Pregnant mare Serum Gonadotrophin (PMS) on anocestrus Buffalo, III, 198.
- Bhattacharya, P. and S. S. Prabhu, Studies on Sex behaviour of artificial Insemination Bulls 1, III, 196.
- Bhattacharya, P., S. S. Prabhu and K. D. Bhaya, Effect of lower protein level in ration on semen production and reaction time of Buffalo Bulls, III, 197.
- Bhattachary, P., S. N. Luktuke, S. Guha, Effect of administration of Gonadotropic Hormones on Sement quality, III, 264
- Bhattacharya, P. and S. S. Prabhu, Seasonal Variation in Conception Rates in Artificially bred cows, III, 197.
- Bhattacharya, P., S. S. Prabhu and U. D. Sharma, Effect of short term feeding of vitamin A deficient rations on the reaction time and semen qualities of breeding bulls, III, 197.
- Bhattacharyya, P., B. K. L. Jonela and K. L. Khanna, Studies of the Activity of Manganese in Calcareous Soils, III, 296.
- Bhattacharya, Rabindra Nath and S. K. Ganguli, Proteins of Pituitary (Posterior) lobe extract: Effect of irradiation as observed by ultraviolet absorption spectra, III, 256.
- Bhattacharya, Sukhamoy and Suresh Chandra Banerjee, On the determination of Thiamine Hydrochloride, III, 155.
- Bhattacharya, Sukhamoy and U. P. Basu, Studies on Vitamin A in Solution: Aqueous System, III, 102.
- Bhattacharya, S. C., B. N. Jayasimha, and P. C. Guha, Some derivatives of 4: 4' Diaminodiphenyl sulphone, III, 91.
- Bhattacharyya, S. C., R. K. Razdan, and P. C. Guha, Study of the sesquiterpene Portion of Piper Cubeba, Linu, III, 85.
- Bhattacharyya, S. C., J. R. Iyengar and P. C. Guha, Azo-dyes of 4: 4' diamino-diphenyl sulphone, III, 90.
- Bhattacharyya, S.C., J. R. Iyengar and P. C. Guha, Thio-ureas of Sulphones and Sulphides, III, 90.
- Bhattacharyya, S.K. and V. Ramakrishna, V. Magnetism and Catalysis, Part I. Magnetic study of Vanadium Catalysts, III, 66.
- Bhattacharyya S. K. and N. Venkataraman, Reactions in the vapour phase Part III The catalytic oxidation of croton aldehyde to maleic acid in the vapour phase, III, 122.
- Bhattacharyya S.K. and S. N. Gopalaswamy, Studies on Differential Thermal Analysis of Catalyst Powders, Part II. The Differential Thermal Analysis of Chromic Oxide Gel, III, 66.
- Bhattacharyya S. K. and P. K. Bhandari, Studies on the Iodination of Solvents, III, 86.
- Bhattacharyya S. K. and S. N. Gopalaswamy, Studies on differential thermal analysis of catalyst powders, Part I. The differential thermal analysis of precipitated oxides of iron, aluminum and nickel, III, 154.

- Bhattacharyya S. K. and S. Sourirajan. Synthesis of propionic acid from ethylene, carbon monoxide and water at high pressures and temperatures in the vapour phase using cobalt catalysis. III, 122.
- Bhattacharyya S. K. and S. Muthu. Studies on Polymerisation. Part I. Thermal Polymerisation of ethylene at high pressures. III, 121.
- Bhattacharyya S. K. N. Ventaktaman N. Studies on surface area and Catalytic activity of some Oxidation Catalysts. III, 65.
- Bhattacharjya, S. S. and J. N. Mitra. Development of Female Gametophyte in *Triumfeta rhomboidea* Jacq., III, 24.
- Bhaya, K. D., S. S. Prabhu and P. Bhattacharya. Effect of lower protein level in ration on semen production and reaction time of Buffalo Bulls. III, 197.
- Bhiday, M. R., V. G. Bhide and G. V. Asolkar. Magnetic Analogue of Joshi-Effect, III, 223.
- Bhiday, M. R. Joshi-Effect with X-rays in Solid Vapour Systems. III, 224.
- Bhiday, V. G. Joshi-Effect in Nitrogen under X-rays (Semi-Ozonizer). III, 224.
- Bhide B. V. and T. R. Ingle. Nitration of benzo- α -pyrone III, 109.
- Bhide B. V. and T. R. Ingle. Investifation of the mucilage from Talimkhana. (N.O. *Asteracantha Longi folia*). III, 109.
- Bhide B. V. and T. R. Ingle. The structure of the mucilage from the seeds of Tulsi (N. O. *Ocimum Sanctum* Linn). Part I. Study of products of hydrolysis III, 110.
- Bhide, B. V. and T. R. Ingle. The structure of tye gum from Drum strick plant, i.e., *Moringa Pterygosperma*. (N. O. *Moringase*). Part I. Chemical investigation of the gum. III, 109.
- Bhide, V. G., M. R. Bhiday and G. V. Asolkar. Magnetic Analogue of Joshi Effect, III, 223.
- Bhowmick, B. On the Directional Intensities of Cosmic Rays. III, 229.
- Bhushan Bharat. Recovery of Naphthalene from Creosote oil Sediment. III, 104.
- Biswas A. B. The X-Ray Crystallographic Structure Analysis of Complex Organic Compounds. III, 73.
- Biswas, B. Para-lavas from Chirimiri Areal Sarguja District. M. P. III, 176.
- Biswas, B. and A. Chaudhuri. Some recent foraminifera and other organic remains from the shore-sand of Bombay, III, 313.
- Biswas, B. Non-diastrophic Sedimentary Structures from the Lower Gondwanas of Chirimiri Area, Sarguja Dist., C. P. III, 179.
- Biswas, B. and A. Chaudhuri. Some Recent Foraminifera and other Organic Remains from the Shore sand of Bombay. III, 179.
- Biswas, H. G. Investigation on the Reduction of armatic Nitro compounds. III, 101
- Biswas, H. G. and N. K. Munshi. An economic Isolation of Berberine from an Indian Source. III, 132.
- Biswas, M. M. Studies in the Behaviour of different substrates towards Yeast Invertase. III, 119.
- Biswas, P. C. Studies of the Whorl in Head Hair of the Oraon. III, 43.
- Botany: Cytology In India with special Reference to Crop Plants—Dr. S. Ramanuiam. II, 127.
- Bose, A. N. and A. C. Chatterji. Variation of Electrical Conductance with Temperature of Aqueous Sodium Oleate Solution in Presence of Different Alcohols and Salt. III, 69.
- Bose, A. N. and Prinati Bose. Studies on synthetic anti-spasmodics. Part I. III, 191.
- Bose, A. N., A. C. Chatterjee and Jagadish Misra. A study of Viskosity of the System Na-Oleate-Water and Butyl Alcohol in Presence of NaCl. III, 68.

- Bose, A. N. and N. K. Roy. The progress of *Plasmodium gallinaceum* infection in native fowls. III, 194.
- Bose, A. N. and C. S. Pande. Formulation of Complex compounds between Urea and Ammonium Nitrate. III, 54.
- Bose, A. N. and A. C. Chatterji. Variation of Electrical Conductance with Concentration of Aqueous Sodium Oleate Solutions in Presence of Different Concentrations of Alcohols, and Salt. III, 68.
- Bose, A. N. and A. C. Chatterji. A Study of Viscosity of the system. Water-Sodium oleate and Different Alcohols. Part I. III, 68.
- Bose, J. L. and N. L. Bose. Isoflavones. Part I. Some nitro Isoflavones. III, 108.
- Bose, P. C. and L. N. Srivastava. Formation of complex between potassium chloride and alkaline earth chlorides. III, 51.
- Bose, P. C. and L. N. Srivastava. Formation of complex compounds between potassium chloride and alkaline earth chlorides, III, 52.
- Bose, P. K. and S. C. Sen Gupta. Constituents of Shellac. Part I. Butolic Acid. III, 115.
- Bose, S., B. M. Thakral and S. Narayanan. The processing of Cow manure for increased egg production. III, 201.
- Bose, S., A. K. Pal, T. D. Mahadevan and R. Narain. The determination of quality in eggs, based upon the physical and chemical characteristics of the eggs. III, 202.
- Bose, Sripati and A. N. Bose. Studies on synthetic anti-spasmodic. Part I. III, 191.
- Bose, Sukumar and Asima Chatterjee. Studies on the Active principles isolated from the leaves of *Aegle marmelos*, Correa, III, 98.
- Bose, S. C. Natural Divisions of the Damodar Valley. III, 185.
- Brahma, S. K., H. K. Mookerjee and D. N. Ganguly, On the life history of *Barbus stigma* (Cuv & Val). III, 328.
- Burma D. P. The Techniqe of Paper Chromatography, its applications and physico-chemicals aspects. III, 155.
- Burma D. P. Effect of the quantity of the chromatographed amino-acids and sugars on their Rf values and the areas occupied by them on the chromatogram in paper chromatography. III, 64.

C

- Chacrabarti, A. S. and K. L. Khanna, Studies in gur quality in Bihar 1. III, 303.
- Chacko, P. I. The bladder-wort, *Utricularia flexuosa* vahl as a competitor for flash food. III, 21.
- Chacko, P. I. and R. Srinivasan. Control of aquatic vegetation with Dicotox. III, 146.
- Chachrvarti, A. S., Satrugnan Prasad, Durga Prasad Srivastava and K. L. Khanna, Studies in storage of gur—III. III, 304.
- Chaki, M. C. and R. N. Sen. On Clifford's parallelism in a Riemannian Spce, III, 8.
- Chakrabarti, S. C., A Unit Identity on Higher Differences. III, 8.
- Chakrabarty, S. C., and Guru Dayal Pershad. Preliminary studies into the viability of immature Weed Seeds. III, 25.
- Chakrabarty, C. H. and M. C. Nath, Studies on the effect of sodium acetoacetate on thiamine. III, 258.
- Chakrabarty (Miss) Preety and P. Nandi. Studies on the isolation of *Azotobacter* in several samples of cultivation soil. III, 38.
- Chakrabarty, S. K. and R. Pratap. On the Dynamo Theory of Geomagnetic Field Variations. III, 226.
- Chakrabarty, S. K. On the Energy Spectrum of the Shower Electrons in Cascade Showers. III, 229.

- Chakrabarty, S. K. On the Methods of Determination of the Response characteristics of Electromagnetic seismographs. III, 11.
- Chakraborti, S. C., An Algebraic Identity on Higher Differences. III, 1.
- Chakraborty, J. N., M. K. Mukherjee and G. S. Roy, Soils of Damodar Valley. I: Soils of Barhi area: Relation between clay content and nutrient status of closely lying areas. III, 301.
- Chakraborty, J. N., M. K. Mukherjee and G. S. Roy, Soils of Damodar Valley: III Phosphate studies: Factors responsible for Fixation of Phosphates. III, 301.
- Chakraborty, N. K. and S. B. Chattopadhyay. Variations in conidial character of *Helminthosporium oryzae* Breda de Haan. III, 33.
- Chakraborty, N. K. P. Basu and P. Nandi. Antibiotic activities of some micro organisms isolated from Bengal. III, 38.
- Chakraborty, Amiya Kumar and Priyada Ranjan Ray. Complex compounds of certain Bivalent metals with Diglycyl-ethylenediamine and Determination of their instability constants, III, 50.
- Chakravarti D. and R. N. Chakravarti. Andrographolide, the Active Constituent of *Andrographis paniculata* Nees (Kalmegh). III, 101.
- Chakravarti Jiban Kumar and Nirmal Kumar Sen. The Sterols from the jute seed oils *Corchorus Capsularis*. Part I. III, 131.
- Chakravarti, N. K. and R. N. Chaudhuri. Observations on the toxicity of White oil. III, 205.
- Chakravarti, R. N. and S. C. Chakravarti. Alkaloids of *Glycosmis arborea* Crrea. III, 100.
- Chakravarti, R. N. and D. Chakravarti. Andrographolide, the Active Constituent of *Andrographis paniculata* Nees (Kalmegh). III, 101.
- Chakravarti, S. C. Anatomical Studies into the Mechanism of Vernalisation II. Anatomical Structure of Stems in Plants raised from vernalised and control seeds. III, 27.
- Chakravarti, S. C., and O. N. Chand, Agronomic possibilities of Mustard Vernalisation in India. III, 291.
- Chakravarti S. C. and R. N. Chakravarti. Alkaloids of *Glycosmis arborea* C rrea. III, 100.
- Chakravarti, A. K. Cytogenetical studies in Musaceae. VI Fragmentation of chromosomes as a physical Basis of speciation in the genus *strelitzia*. III, 23.
- Chakravarti, A. K. Cytogenetical studies in zingiberaceae. III, 30.
- Chakravarty, A. P. The Aetiology of Eclampsia and Pre-Eclampsia Texaem. III, 207.
- Chand, O. N. and S. C. Chakravarti, Agronomic possibilities of Mustard Vernalisation in India, III, 291.
- Chanda. M. S. and H. L. Bami. Biguanides as Potential Antimalarials. III, 113.
- Chandratreya, P. V. and N. R. Tawde. Apparent Splitting of 5460 Line of Mercury. III, 214.
- Chandy, Miss M., Notes on flying fishes of the genus *cypselurus*. III, 331.
- Chari, S. T. and R. Venkataraman. Studies on macerel fat variations: correlation of plankton fat with fat of fish, III, 329.
- Chari, S. T. and R. Venkataraman. The occurrence of trimethylamine oxide in a few Indian marine fishes, III, 329.
- Chatterjee A. C. and R. P. Rastogi. Activity of Water and its Temperature Dependence in Supersaturated Solutions of electrolytes. III, 69.
- Chatterjee A. C., A. N. Bose and Jagadish Misra. A Study of Viscosity of the System Na-Oleate-Water and Butyl Alcohol in Presence of NaCl. III, 6.
- Chatterjee A. C. and R. P. Rastogi. Role of Foreign Substances in the Release Supersaturation. III, 67.

- Chatterjee, B. K. and G. D. Kumar. Proportion of the Upper and the Lower extremities of the body of the hill tribes of Travancore and Cochin, III, 44.
- Chatterjee A. C. and R. P. Reshoga. Temperature Dependence of Vapour pressure in Supersaturated Solutions, III, 68.
- Chatterjee B. and A. K. Ganguly. Broken Bonds in Quartz, III, 65.
- Chatterjee Asima and Sukumar Bose. Studies on the Active principles isolated from the leaves of *Aegle marmelos*, Correa, III, 98.
- Chatterjee Asima and Anima Chaudhuri. On the Constitution of Marmin, a new coumarin isolated from the immatured bark of *Aegle marmelos*, Courrea, III, 97.
- Chatterjee, B., P. G. Gosh and A. T. Pal. On Testing. Standarisation and Blending of Foundry Sands, III, 234.
- Chatterjee, B. and P. C. Ghosh, The Engineering Properties of a Clay Loam Soil of West Bengal, III, 239.
- Chatterjee, B. and P. C. Ghosh, Malleablising of Cast Iron in Hydrogen, III, 241.
- Chatterjee, B. and P. P. Das, Decomposition of Carbon Monoxide in Presence of Nickel as Catalyst, III, 238.
- Chatterjee, B. B. Initial motions of the elements of a seismograph and their connections with the response characteristics of the seismograph, III, 11.
- Chatterjee, B. K. Do the various tribes of India represent only different ethnic types of a race or different races?, III, 44.
- Chatterjee, B. K. and G. D. Kumar. Relation of stature, girth of chest and the weight of body of different hill tribes of Travancore and Cochin State, III, 44.
- Chatterjee, B. K. and G. D. Kumar, Relation between Stature and Sitting height of the different hill of South Western extremity of Indian Peninsula, III, 43.
- Chatterjee, G. P., Mechanism of Atmospheric Corrosion with Reference to some Copper Base Alloys, III, 247.
- Chatterjee, G. P., "X-ray Diffraction studies of a binary alloy containing metals with dissimilar crystal structures, valencies and ionic radii, III, 244.
- Chatterjee, G. P., A New type of Age-Hardening Phenomenon, III, 240.
- Chatterjee, G. P. and P. C. Mukherjee, Studies on the behaviour of Cu-Mg alloys against atmospheric Corrosion, III, 239.
- Chatterjee, G. P. and P. C. Mukherjee, 8
- Chatterjee, G. P., K. C. Shome and R. Ganguly, Effects of Anodic Surcharging on the Behaviour of some plain carbon steel, III, 241.
- Chatterjee, L. D. Anharmonic Pulsations of a Stellar Model, III, 12.
- Chatterjee, S. C. The Charnockites of the Mor valley, Santhal Parganas, Bihar, III, 175.
- Chatterji, S. K. and H. D. Ganguly. Detection of hydrocyanic acid in decomposed. Viscera, III, 262.
- Chatterjee, S. K. and H. D. Ganguly. A case of accidental poisoning (non fatal) by taking ground nuts (*chinibadam*). III, 194.
- Chatterjee S. K. and H. N. Das-Gupta. (2) Studies on Ceramic Raw-materials. Part III, III, 132.
- Chatterjee S. K. and H. N. Das-Gupta. (1) Lux (Red Mud) as a raw material for Rutile Bodies, III, 132.
- Chatterjee, S. N., P. Bhattacharya and S. S. Prabhu. Gestation periods of Indian III, 69.
- Chatterjee, S. N., P. Bhattacharva and S S Prabhu. Secondary "Sex-ratio" of normal births in Indian Cattle II, III, 196.
- Chatterjee, P. K. Some Observations on Supercooling and Theory of the Liquid State, III, 211.

- Chatterji A. C. and R. D. Srivastava. Adsorption Equation Applicable in solutions. Breeds of Cattle II. III, 195.
- State. III, 211.
- Chatterji A. C. and A. N. Bose. Variation of Electrical Conductance with Temperature of Aqueous Sodium Oleate Solution in Presence of Different Alcohols and Salt. III, 69.
- Chatterji, A. C. and R. D. Srivastava. Adsorption from mixtures by animal charcoal Pt. (1) (Effect of Salts on the adsorption of acids). III, 69.
- Chatterji A. C. and A. N. Bose. Variation of Electrical Conductance with Concentration of Aqueous Sodium Oleate Solutions in Presence of Different Concentrations of Alcohols, and Salt. III, 68.
- Chatterji A. C. and R. D. Srivastava. Adsorption from mixtures by animal charcoal. Pt. (II). (Effect one acid on the adsorption of other acids). III, 70.
- Chatterji A. C. and R. D. Srivastava. Studies on the Adsorption from Non-aqueous Solvents. Pt. (II). III, 70.
- Chatterji A. C. and A. N. Bose. A study of Viscosity of the system: Water-Sodium oleate and Different Alcohols. Part I. III, 68.
- Chatterji A. C. and M. C. Rastogi. Adsorption of the Sole and their constituent Ions by Freshly Precipitated Sparingly Soluble Salts Part I. III, 67.
- Chatterji, Bani. Music, the hand-made of Psychology, III, 284.
- Chatterji, N. N., Psychology of Schizophrenia, III, 281.
- Chatterji, Dr. S. K. and H. D. Ganguli. Extraneous matters in biological materials. (Viscera, Vomit etc). III, 193.
- Chatterji Dr. S. K. and Sen Gupta. Table for finding the weight per gallon of spirit by Sike's A Hydrometer for "Indications" O.O. to 6.6. III, 156.
- Chatterji, S. K., and Amiya Ghosal, An observation on the pH and alkali reserve content of blood in cases of carbon monoxide poisoning, III, 257.
- Chatterji, S. N. Urgency of sulphone treatment in same neural cases of leprosy. III, 204.
- Chattopadhyay, Dhurjati P. and N. and N. C. Ghosh, Urinary excretion of N'methylnicotinamide by rabbits, III, 259.
- Chattopadhyay, Haripada and Sactidanand Banerjee, Studies on the Ascorbic Oxidase Activity of some Common Indian Pulses during germination, III, 271.
- Chattopadhyay, H. P., and S. Banerjee, Effect of germination on the biological value of proteins of pulses, III, 262.
- Chattopadhyay, H. P. and S. Banerjee, Effect of germination on the vitamin E content of pulses, III, 260.
- Chattopadhyay, K. P. Culture Contact and Changes in the Rigvedic Society, III, 46.
- Chattopadhyay, S. B., S. K. Sen Gupta, N. P. Das and P. Basu. Observations on the incidence of stem rot of jute caused by *Macrophomina phaseoli* (maubl.) Ashby, III, 36.
- Chattopadhyay, S. B. Trial of different seed treating Fungicides for control of primary seed borne infection of *Helminthosporium oryzae* Breda de Haan, III, 36.
- Chattopadhyay, S. B. and N. K. Chakraborty. Variations in conidial character of *Helminthosporium oryzae* Breda de Haan. III, 33.
- Chattopadhyay, S. B. Assessment of infection of *helminthosporium oryzae* Breda de Haan on paddy. III, 35.
- Chattopadhyay, S. B., Trial of different fungicides for control of early blight disease of potato caused by *Alternaria Solani* (E. and M.) Jones and Groult. III, 35.

- Chaudhuri, A. and B. Biswas, Some recent foraminifera and other organic remains from the shore-sand of Bombay, III, 313.
- Chaudhuri, A. and B. Biswas. Some Recent Foraminifera and other Organic Remains from the Shore sand of Bombay. III, 179.
- Chaudhuri Anima and Asima Chatterjee. On the Constitution of Marmin, a new coumarin isolated from the immatured bark of *Aegle marmelos*, Correa. III, 97.
- Chaudhari, K. R. and D. V. Gogate. A Study of the Motion of a Solid Sphere through a Liquid Column. III, 209.
- Chaudhuri, R. N., M. N. Rai Chaudhuri and B. N. Dutta. Clinical trial of M-5943 (A new Chloro-Derivative of Paludrine). III, 205.
- Chaudhuri, R. N. and N. K. Chakravarty. Observations on the toxicity of White Oil. III, 205.
- Chaudhuri, S., K. Mitra and S. Swaroop, Haematological and biochemical studies in normal adult women of nursing profession. III, 254.
- Chauhan V. B. S. and M. R. Nayar. Relation between adsorption and Base Exchange Capacity of Soils. III, 70.
- Chemistry: Baeyer's Strain Theory and its Aftermath Dr. R. D. Desai. II, 81.
- Chendrasekhar, M. R., M. Swaminathan and V. Subrahmanyam, Analysis of Ragi and Ragi malt, III, 274.
- Chibber, V. N. A Study of the Geology and Petrology of the Deccan Trap, near Jabalpur, M. P. III, 175.
- Chhibber, V. N. The Geology and Petrology of the Granites and the Associated Basic Rock, near Jabalpur, Madhya Pradesh. III, 175.
- Chhibber, V. N. On the Alluvial Deposits of the Narbada Valley, near Bheraghat, Jabalpur District, M.P. III, 179.
- Chhibber, V. N. The Economic Minerals of the Region near Jabalpur and Bheraghat, M.P. III, 183.
- Chidambaran, K. and G. K. Kuriyan, Certain observations on the bionomics and fishery of the Big-jawed Jumper *Lactarius Lactarius* Cuv. and Val., III, 327.
- Chidambaram, K. and G. K. Kuriyan, The fluctuation of the blue green algae *Trichodesmium erythraeum* Ehrend, in the plankton off Krusadal Island, Gulf of Mannar. III, 338.
- Chidambaram, K. and G. K. Kuriyan, Fluctuation of Diatoms and Copepods in the plankton of Krusadal Sea with their inter-relationship and relation to hydrographical conditions, III, 338.
- Chaudhuri, D. K., A new method for the estimation of Nicotinic Acid in Biological Materials, III, 276.
- Chitale R. P. and M. C. Nath. Effect of Vitamine B1 on the Bio-synthesis of Vlt. C in Lecuminous Seeds (Green Gram). III, 121.
- Choudhary, B K and S C Sen. Uptake of Phosphatic Salts by Sugarcane Plant in water cultures, III, 294.
- Choudhury, M., N. K. Saha and L. Kasturi Ranjan, Absolute Neutron Flux from a Ra Be Neutron Source. III, 228.
- Chowdhary, Uma, Indian adantation of the thematic apperception test of Murray and its application India population, III, 286.

D

- Daroga R. P., P. R. Bavdekar and B. R. Walavalkar. Rate of Settling of Commercial Lime Suspensions. Part I. Effect of the Amount of Water Used for Hydration. III, 147.

- Daroga R.P., P. R. Bavdekar and B. R. Walavalkar. Rate of Settling of commercial Lime Suspensions. Rate of Settling of commercial Lime Suspensions. Part III. Effect of Particle Size of Lime. III, 148.
- Das, D. P., N. L. Jain and Girdhari Lal, Utilization of waste lime pulp, III, 305.
- Das, D. P., N. L. Jain and Girdhari Lal, Preliminary observation on the packing of orange juice, III, 304.
- Das K. G. and P. P. Pillay. Isolation of Crystalline non-typical constituents from the fixed oil of *Calophyllum Inophyllum* (Linn.). III, 112.
- Das K. G. and P. P. Pillay. Purified Oil of *Calophyllum Inophyllum* (Linn.). III, 111.
- Das K. G. and P. P. Pillay and N. Thanukrishnan. Chemical examination of the Roots of *Chonemorpha Macrophylla* (G. Don.). III, 113.
- Das, K. L. On the occurrence of Limestone at the border of Ranchi and Hazaribagh Districts, Bihar. III, 176.
- Das Gupta, N. N., S. P. Ray Chaudhuri and A. Guha, A new method for the study of the chromosomes of grasshoppers by the electron microscope, III, 310.
- Das, N. P., S. B. Chattopadhyay, S. K. Sen Gupta and P. Basu. Observations on the incidence of stem rot of jute caused by *Macrophomina phaseoli* (Maub.) Ashby, III, 36.
- Das, P. N., Magnetic Amplifier with Stalloy Core, III, 248.
- Das, P. P. and B. Chatterjee. Decomposition of Carbon Monoxide in Presence of Nickel as Catalyst. III, 238.
- Das Sarma. Basudeb and Priyada Ranjan Ray. On the Stability of Inner-Metallic Complexes. III, 48.
- Das, Sami Kumar. Ilmenite-monazite sands of Narsipatnam, Visakhapatnam District. III, 168.
- Das S. N. and B. P. Gyani. Thermodynamics of Evaporation of Liquids, Part II. III, 77.
- Das, S. R. A Mathematical Analysis of the Phenomena of Human Twins and Higher Plural Births, Part I. Twins., III, 47.
- Das, S. R. A note on votive clay figurines used in a folk Rite of Bengal (Illustrated). III, 46.
- Das, S. R. A Note on some folk agricultural rites. III, 46.
- Das, Srimant Lal. Response psychology and interaction between mind and matter. III, 281.
- Das Gupta, M. L., Fuse-Breaker Co-Ordination for Primary Distribution System. III, 249.
- Das Gupta, H. N. and S. K. Chatterjee. (2) Studies on Ceramic Raw-materials. Part III. III, 132.
- Das Gupta, H. N. and S. K. Chatterjee. (1) Lux (Red Mud) as a raw material for Rutile Bodies. III, 132.
- Das-Gupta S. J. A Modification of the Method of Preparation of 5-Chloro Acridine Derivatives. III, 97.
- Das Gupta (Miss) C. and Miss S. Baruah and P. Nandi. Selection of better strains of *Aspergillus niger* for the production of citric acid from sugars. III, 34.
- Das Gupta S. M., Temperature Sensitive Paints. III, 238.
- Das, U. N. and S. M. Banerjee. Study of normal bone marrow cytology in Orissa. III, 253.
- Daspande, S. K. Standardisation of Group test of general mental ability (in Hindi No. 3-4/51 R H II.) III, 279.
- Dass, C. M. S. Multipolar division in *Laccotrephes maculata* Fabr. III, 313.
- Dass, R. B. Study of Plant Succession on Khanheri National Park. III, 19.
- Datar D. S. and Miss Razia Osmani. Thermal Decomposition of Sodium Sulphate. III, 67.

- Datar D. S., Eshwar Raj Sexena and S. Husian Zaheer. White Cement from the sludge after the recovery of potash from Felspar. III, 135.
- Datar D. S. and Eshwar Raj Sexena. Study on Devarkunda Calcites. III, 135.
- Datar D. S. and H. A. Khan. Activated Charcoal from Groundnut Hulls: use of Zinc Chloride as an Activating Agent. III, 137.
- Datar D. S. and K. N. Moorthy. Preparation of Iron Sulphate from Coal Pyrites. III, 136.
- Datar D. S. and K. N. Moorthy. A new method for the preparation of ferrous Sulphate from iron pyrites. III, 136.
- Datar D. S. and Miss. Razia Osmani. Thermal Decomposition of Calcium Sulphate. III, 136.
- Datar D. S. and H. A. Khan. Activated Charcoal from Ground Nut Hulls: Use of Ferric Chloride as activating Agent. III, 137.
- Datar D. S. and K. N. Moorth. A method for obtaining pure precipitated manganese dioxide from Pyrolusite. III, 137.
- Datta, Amiya and H. N. Rai Chaudhuri. Comparative anatomical studies on the leaves of *Hyoscyamus niger* L. and *H. muticus* L. III, 42.
- Datta, Amiya. Pharmacognostic studies on the leaves of *Eucalyptus globulus* Labill, and allied species found in India, III, 42.
- Datta, D. Comparative anatomical studies on Indian cinnamon barks, III, 41.
- Datta, D. and H. N. Rai Chaudhuri. Pharmacognostic studies on *Euphorbia pilulifera* Linn. III, 41.
- Datta, N. P. and H. Gurubasavaraj, Phosphatic fertilization of Berseem (*Trifolium*) influence of boron and Molybdenum. III, 300.
- Datta, Radhanath. Petrography of the Rajmahal Lava Rocks from Begum Pahari, Santal Parganas, Bihar. III, 178.
- Datta, S. C. and H. N. Rai Chaudhuri. Effect of different physiological factors on the growth and alkaloid content of *Datura metel* Linn. III, 41.
- Datta, S. C. and B. Mukerji. Pharmacognosy of Indian Bark drugs, III, 41.
- Datta, T. P., Preliminaries of Design, Patent & Trade Mark in India, III, 236.
- De, Paritosh and Mihir Sen Gupta. Studies on Ion-Exchange and Electro-kinetic Properties of Synthetic Cation Exchanges. III, 64.
- De, Ranajit Kumar, Life History as a method of Tension Study. III, 286.
- De Sircar, N., U. P. Basu and M. Sen Gupta. On the quality of groundnut oil. III, 302.
- De, S. S. and T. Venkatasubramanian, Molecular distillation of shark liver oil. III, 260.
- De, S. S., S. C. Balasubramanian, M. Ramchandran, T. Viswanathan, Amino-acid composition of Indian food-stuffs. III, 261.
- De, S. S. and T. A. Venkatasubramanian, The effect of lactose and galactose on the utilization of fat. III, 256.
- De, S. S. and B. M. Pal. Mutual supplementation in vegetable proteins. III, 261.
- De, S. S. and S. Balakrishnan, Effects of levels of fat and protein on the intestinal synthesis of thiamine in rats. III, 259.
- De, S. S. and D. K. Nandi, Vegetable milk from soyabean, groundnut and ragi. III, 261.
- Deb, Asit. What men went for their jobs, III, 283.
- Deb, C. and S. Banerjee, Blood changes in scurvy. III, 260.
- Deb, S. K., S. S. Guha and P. C. Guha. Studies in Antimalarials, Part III. Some aryl and alkyl carbo-diguanidines. III, 87.
- Deshmukh, G. S. and K. M. Sankaranarayanan. Preparation of Pure Ceria. III, 48.
- Deshmukh, G. S. Arsenophotungstic Acid—A Micro Reagent for Cerium. III, 153.
- Deshmukh, G. S. Estimation of Phosphorus by Ceric Sulphate. III, 154.

- Deshmukh, G. S. and B. R. Sant. Estimation of Selenious Acid by As. 253. III, 152.
- Deshmukh G. S. and K. V. Nayak. On the Solubility of Rare Earth Hydroxides in Aqueous Sodium Potassium Tartrate. III, 152.
- Deshmukh G. S. and J. Xavier, Analytical Chemistry of Thorium. Part IV. Estimation by O-tolidine, dianisidine and p-phenylene diamine. III, 151.
- Deshmukh G. S. and J. Xavier, Analytical Chemistry of Thorium. Part III. Estimation by pyrogallig acid. III, 151.
- Deshmukh G. S. and J. Xavier, Analytical Chemistry of Thorium. Part V. Estimations by O-phemetidine and O-anisidint. III, 151.
- Deshmukh G. S. and K. M. Sankaranarayanan. On the Solubility of Ce La and Th Oxalates in Suphuric Acid. III, 150.
- Deshmukh G. S. and B. R. Sant. Determination of Elementary Red Phosphours by Potassium Bromate. III, 152.
- Deshmukh G. S. and J. Xavier, Analytical Chemistry of Thorium. Part II. estimation by stearic acid. III, 151.
- Deshmukh G. S. and B. R. Sant. Arsenious Oxide a Primary Standard for the Determination of Copper. III, 153.
- Deshmukh G. S. and K. M. Sanakranarayanan. Estimation of Silver by Selenious Acid. III, 149.
- Deshmukh G. S. and J. Xavier. Analytical Chemistry of Thorium. Part I. Estimation by m-hydroxy benzoic acid. III, 152.
- Deshmukh G. S. and K. M. Sankaranarayanan. Estimation of Silver by Selenious Acid. III, 149.
- Deshmukh G. S. and J. Xavier. Analytical Chemistry of Thorium. Part I. Estimation by m-hydroxy benzoic acid. III, 152.
- Deshmukh, G. S. and K. M. Sankaranarayanan. Estimation of Silver by Selenious Acid. III, 149.
- Deshmukh G. S. and K. M. Sankaranarayanan. Eseimation of Selemious acid by Mercuric Nitrate. III, 150.
- Deshmukh, G. S. and K. M. Sankaranarayanan. Determination of Selenious Acid by Thioures.. III, 150.
- Deshmukh, V. K. and U. K. Kanitkar, Imbibition of water by seed of Jowar Varieties, III, 291.
- Deshpande C. M. and S. K. K. Jatkar. Induction, Dipole Moments and Infra Red Spectra. III, 192.
- Deshpande S. M. and R. A. Sharma Study of Joshi effect in Benzene in different discharge tubes: Part I. Influence of applied potential.
- Deshpande S. M. and R. A. Sharma. Study of Joshi effect of Benzene: Part III influence of Pressure and Temperature. III, 60.
- Deshpande S. M. Studies of Joshi Effect in Carbon monoxide. III, 59.
- Despande S. M. and R. A. Sharma. Study of Joshi Effect in Benzene: Part II Influence of 'aging' A. C. supply frequency and Intensity and frequency of lighe. III, 60.
- Deoras, P. J. and D. R. Rand. Studies on Poona Flies 1. III, 195.
- Dev Sukh, G. S. Krishna Rao and P. C. Guha. A study of the Essential Oil from wood of Cedrus Deodara. III, 91.
- Dev Sukh, G. S. Krishna Rao, and P. C. Guha. A study of the Essential Oil from the Oleo-resin of Dipterocarpus Indicus. III, 91.
- Dey, A. K., Valudavur Meteorite. III, 185.
- Dey Sarkar, B. K. and B. K. Kar. Physiology of Fibre Growth in Jute (Corchorus). III, 293.

- Devi, K. Paravati and N. A. Ramaiah. Surface Sensitivity of Joshi Effect in Water Vapour. III, 216.
- Devi K. Pravati and N. A. Ramaliah. Comparative Studies of Joshi effect in H_2O and H_2S . III, 61.
- Dhar A. N. Shellac Aniline Formaldehyde Moulding Powder. III, 110.
- Dhar, A. N. Methylation of Shellac. III, 110.
- Dhingra D. R. and M. G. Gupta. Studies in the Preparation of Photographic Plates. III, 142.
- Dhigra D. R. and M. G. Gupta. A New Process for the preparation of Chemical Gold-thread. III, 143.
- Dhingra D. R., M. G. Gupta and Girish C. Joshi. Studies in the preparation of Photographic Printing Papers. III, 144.
- Dhingra, Lekh Raj and M. R. Madhok, Losses of Nitrogen from Urine under different conditions. III, 297.
- Dnyansagar, V. R. A contribution to the Embryology of *Neptunia triquetra* benth. III, 23.
- Dole, K. K. and Nene M. K. Reaction of Nitrates by Alumino-Thermic Reaction. III, 54.
- Dole, K. K. and P. S. Kulkarni. Investigations in Viscosities of Milks. III, 72.
- Dole, K. K., D. D. Karve and B. W. Kelkar. Adsorption of dyes on metallic surfaces. Part VII. III, 73.
- Dole, K. K. and V. A. Saraf, Dehydration of Castor Oil by Tetra-Boro-Hypo-Phosphoric Acid as a catalyst, III, 139.
- Dole, K. K. and A. S. Rajadhyaksha, Dehydration of Castor Oil with "Mixed Alkane Sulphonic Acid" As a catalyst. III, 139.
- Dongree, M. B. and M. C. Nath, The effect of intermediary fat metabolites on the process of transmethylation in liver. III, 256.
- Doss, K. S. G. and H. P. Agarwal. Determination of the Value of 'E' of absolute reaction rates, for the quinhedrone system. III, 78.
- Dutt, M. K., Polyploidy in the Spermatocytes of some Acridids. III, 312.
- Dutta, B. N., R. N. Chaudhuri and M. N. Rai Chaudhuri. Clinical trial of M-5043 (A new Chloro-Derivative of Paludrine). III, 205.
- Dutta, D. K. and A. P. Kapur, Studies on the bionomics of the semi-aquatic Grasshopper *Gesonula punctifrons* Stol. III, 339.
- Dutta, M. Concepts of Reversible Variations, Entropy, etc. in a General Probabilistic Method. III, 211.
- Dutta, N. K. and K. G. N. Narayanan. Liberation of histamine by Gobra (*Naja naja*) venom from isolated diaphragm of the rat. III, 192.
- Dutta N. L. and J. L. Bose. Isoflavones. Part I. Some nitro Isoflavones. III, 108.

E

- Engineering & Metallurgy: Technical Education—Dr. J. N. Basu. II, 259.
- Esh, G. C. and U. P. Basu, The relation between the yield and the nutritive value of wheat. III, 303.
- Esh G. C. Studies on the stability of Thiamine Mononitrate and Hydrochloride in Pharmaceutical Preparations. III, 96.
- Esh, G. C. and K. N. Bagchi. Nutritional Survey on Available Food Materials. Part I. Wheat, Flour, Atta and Millets. III, 116.
- Esh, G. C. and K. N. Bagchi. Nutritional Survey on Available Food Materials Part II. The effect of parboiling, milling and storage on the nutritive value of Rice. III, 116.

F

- Farooq, M. Omar, Aiyid Shamin Ahmad and Mohd. Sharif. Methyl Amine-Acetaldehyde Complex. III, 163 & 164.
- Farooque, M. and S. C. Sen. A simple method for the estimation of Nitrate Nitrogen in calcareous soils. III, 298.

G

- Gadgil, J. S. and M. C. Nath. Inhibition of 2-SH enzymes by intermediary fat metabolites. III, 256.
- Ganapati, P. N., On a new Flagellate parasite from the gut of a Pentatomid Bug *Dydescus* Sp. III, 313.
- Ganguli, H. D. and Dr. S. K. Chatterji. Extraneous matters in biological materials, (Viscera, Vomit etc). III, 193.
- Ganguli, N. C. and S. C. Roy. Studies on the bio-synthesis of ascorbic acid. III, 259.
- Galagali, R. R. J. and B. R. Marathe. Joshi Effect in H₂ Using a Discharge Tube with External Plane Parallel Electrodes: Variation of the Diameter of the Electrodes and Their Distance from the Tube. III, 222.
- Galagali, R. J. and B. R. Marathe. Studies of Joshi Effect under X-ray Irradiation. III, 224.
- Galagali, R. J. and B. R. Marathe. Investigation of Joshi Effect in Geissler Tube under D. C. Excitation. III, 220.
- Ganguly, S. K. and Rabindra Nath Bhattacharya. Proteins of Pituitary (Posterior) lobe extract: Effect of irradiation as observed by ultraviolet absorption spectra. III, 256.
- Ganguly, A. K. and B. Chatterjee. Broken Bonds in Quartz. III, 65.
- Ganguly, D. N., H. K. Mookerjee. On the biological productivity of a typical brackish water Tarn (Bheri) of lower Bengal. III, 338.
- Ganguly, D. N., H. K. Mookerjee and B. Mookerjee. The development of the vertebrate column in *Anguilla japonica*. III, 328.
- Ganguly, D. N., H. K. Mookerjee. The development of the vertebrate column in *Anguilla japonica*. III, 328.
- Ganguly, D. N., H. K. Mookerjee and Ghosh, Miss Gouri. The formation of synovial acidity in different joint of the skeletal system of the Vertebrates. III, 326.
- Ganguly, D. N., H. K. Mookerjee and S. K. Brahma. On the life history of *Barbus stigma* (Cuv & Val)., III, 328.
- Ganguly, D. N., H. K. Mukherjee, and B. N. Mitra. Preliminary observation on the distribution fry collection centres, method of collection and the fry trade in the river Bhagirathi of West Bengal. III 328.
- Ganguly, H. D. and S. K. Chatterji. Detection of hydoreyule acid in decomposed Viscera. III, 262.
- Ganguly, H. D. and S. K. Chatterjee. A case of accidental poisoning (non fatal) by taking ground nuts (chinabadam). III, 194.
- Ganguly, R., G. P. Chatterjee and K. C. Shome. Effects of Anodic Surcharging on the Behaviour of some plain Carbon steel. III, 241.
- Ganguly, S. K., Proteins of pituitary (posterior) lobe extract: Reactivity against 2:6-dichlorophenol indophenol. III, 257.
- Gattani, M. L. Hydrophobic colloidal sulphur spray for wheat rust control. III, 307.
- Geology & Geography: India's Mica Industry. Dr. L. A. N. Das. II, 101.
- Ghar, T. L. Rame and J. Mathur. Electrodeposition of Cadmium from Cyanide-Free Baths: Cadmium Sulphate Solutions. III, 237.
- Ghosal, Amiya and S. K. Chatterji. An observation on the pH and alkali reserve content of blood in cases of carbon monoxide poisoning. III, 257.

- Ghosal, R. K. and S. C. Sen, Reactions of different concentrated solutions of Methylene Blue during estimation of reducing sugars with Alkaline Potassium Ferricyanide solutions, III, 297.
- Ghosal, S. C. and S. K. Gupta, Isolation of *V. Chelerae* from house flies from a Cholera Ward, III, 204.
- Ghoshal, S. N., Elastic Scattering of 32 Mev Protons from Gold, III, 223.
- Ghose, K. D., A study of Gifted children, III, 284.
- Ghosh, Asok and Amiya B. Kar, Seasonal Periodicity in the Grounds of the Common Indian Catfish *Heteropneustes Fossilis* (Bloch), III, 275.
- Ghosh, A. K. and R. B. Mazumdar, The Age of the Mandi Salt-Belt, III, 182.
- Ghosh, A. M. N. and A. K. Saha, On Some Sapphirine-bearing Rocks from the Khasi Hills, Assam, III, 172.
- Ghosh A. R. and S. N. Mukherjee, Electro-chemical Properties of Solutions of Yeast Nucleic Acid, III, 119.
- Ghosh, Miss Gouri, H. K. Mookerjee and D. N. Ganguly, The formation of synovial activity in different joints of the skeletal system of the Vertebrates, III, 326.
- Ghosh, Jagat Jiban, Studies on pH conditions for the growth of rice-inhabiting fungi, III, 34.
- Ghosh Jagat Jiban, Comparative biological availability of iron from ricegrains fortified with ferrous sulphate, ferric chloride and ferric orthophosphate, III, 118.
- Ghosh, Jagat Jiban, Effect of temperature on the growth of the rice-inhabiting fungi, III, 34.
- Ghosh Jagat Jiban, Studies on the critical moisture requirements of some of the rice-inhabiting fungi.
- Ghosh, Mrinamajee and Arun Kumar Saha, Theories of Light Effect, III, 226.
- Ghosh, N. C. and S. Banerji, Biosynthesis of nicotinic acid in germinated pulses, III, 259.
- Ghosh, N. C. and Dhujati P. Chattopadhyay, Urinary excretion of N-methylnicotinamide by rabbits, III, 259.
- Ghosh, N. L. On the Equilibrium of a thin atmosphere round a heavy central cores Spheroidal and anchoring configurations, III, 9.
- Ghosh, N. N. Derivation of Lagrangian and Hamiltonian Equations of Motion from the Dynamics in Hyper-space, III, 10.
- Ghosh, P. B., Improvements in the Construction of Partitions, Solid Walls, Plinth, Foundation, Bridge Piers, and similar other structures.
- Ghosh, P. C. and B. Chatterjee, The Engineering Properties of a Clay Loam Soil of West Bengal, III, 239.
- Ghosh, P. C. and B. Chatterjee, Malleablising of Cast Iron in Hydrogen, III, 241.
- Ghosh, P. C., A. T. Pal and B. Chatterjee, On Testing, Standardisation and Blending of Foundry Sands, III, 234.
- Ghosh, S. and A. N. Bose, On a new factor in Liver preparation, III, 205.
- Ghosh, S. D. and M. S. Sadashivalah, Occurrence of Chondrodite in the Calc-silicate rocks of Latchar, Palamau District, III, 167.
- Ghosh T. N., A. K. Kundu and A. Ray Choudhuri, Search for New Antispasmodics. Part IV, III, 96.
- Gideon, P. W. and V. B. Marathe, A preliminary survey of the fresh water plankton from some waters of the Bombay Karnatak, III, 338.
- Giri K. V. and J. Sri Ram, Starch Synthesising Enzymes of Green Gram, III, 116.
- Godbole E. W. and Vijayanathan K. S. On the influence of 'terminal reversal' on the threshold potential V_m , III, 57.
- Gopal Ram, Nature of Iodine Solutions, Part I, III, 72.

- Godbole E. W. and Visvanathan K. S. Influence of 'terminal reversal' on the magnitude of the positive and negative Joshi effect, III, 57.
- Gogate, D. V. and K. R. Chaudhari. A Study of the Motion of a Solid Sphere through a Liquid Column, III, 209.
- Goil, M. M., Distribution of digestive enzymes in Malpighian tubes of cockroach (*Periplaneta americana*), III, 258.
- Gopalaswamy S. N. and S. K. Bhattacharyya. Studies on Differential Thermal Analysis of Catalyst Powders. Part II. The differential Thermal Analysis of Chromic Oxide Gel., III, 66.
- Gopalaswamy S. N. and S. K. Bhattacharyya. Studies on differential thermal analysis of catalyst powders. Part I. The differential thermal analysis of precipitated oxides of iron, aluminum and nickel, III, 154.
- Goswami A. An Electron diffraction study of epitaxial Crystal growth in Electrodeposits and the Relief of Epitaxial stress by Rotational Slip, III, 62.
- Goswami M. N. and M. M. Roy. Studies on the desulphurisation of high-Sulphur Indian Coals, III, 128.
- Goswami M. N. and K. P. Koley, Investigation on the production of High-octane Aviation Fuels, Decanes and Octanes, III, 130.
- Goswami M. N. and K. P. Koley. Production of Acetone from Ethyl Alcohol in one step process, III, 129.
- Govindarajan, S. V. and H. G. Gopal Rao, Influence of minor elements on Mysore Salts and Crops, Response of Ragi to Zinc Salts, III, 294.
- Govindarajan, S. V. and B. V. Venkata Rao, Associated growth of Legumes and Cereals, III, 290.
- Govindarajan, S. V. and B. V. Venkata Rao, Phosphate manuring of legumes—its influence on Nitrogen Fixation and on the yield on succeeding crop of cereal, III, 300.
- Govindaswamy, S. "Cytological studies of a sterile diploid *Eumusa*" 1 Safet-velchi, III, 40.
- Gowda, B. N. Bole and S. P. Ray-Chaudhuri, Further evidences on the occurrence of XO mechanism of sex determination in spiders, III, 311.
- Gowda, B. N. Bole and S. P. Ray-Chaudhuri, A study on the chromosomes during spermatogenesis in two spiders *Hersilia savygni* and *steogodyphus sarsinorum*, III, 311.
- Guha, S., S. N. Luktuke, and P. Bhattacharya, Effect of administration of Gonadotropic Hormones on Semen quality, III, 264.
- Guha, A., S. P. Ray Chaudhuri and M. N. Das Gupta, A new method for the study of the chromosomes of grasshoppers by the electron microscope, III, 310.
- Guha P. C. and U. G. Nayak. Essential Oil from *Mentha Arvensis*, III, 86.
- Guha P. C. and P. R. Gupta. Studies in Quinolyl-biguanides, III, 86.
- Guha P. C., K Raman and M. Raghavan. Studies in Antimalarials, Part VI. Some N1—and N5—substituted Biguanides, III, 89.
- Guha P. C., S. N. Sur and S. S. Guha. Studies in Antimalarials, Part IV. Some aryl and alkyl sulphuryl diguanidines, III, 88.
- Guha P. C., S. S. Guha and S. K. Deb. Studies in Antimalarials, Part III. Some aryl and alkyl carbo-diguanidines, III, 87.
- Guha P. C. and P. R. Gupta. Preparation of Isopropylidene-dimalonic ester, III, 84.
- Guha P. C. and U. G. Nayak. Essential Oil from *Ocimum Killimanjaricum*, Guerke, III, 85.
- Guha P. C. and S. S. Guha. Preparation of Amines: Simultaneous Hydrogenation and Ammonolysis of Ketones, III, 87.
- Guha P. C., R. K. Razdan and S. C. Bhattacharyya. Study of the Sesquiterpene Portion of Piped Cubeba, Linu, III, 85.

- Guha P. C., K. V. Viswanathan and M. Raghavan. Studies on Antimalarials, Part V. Some N1—and N3—substituted Derivatives of Metanilamide, III, 88.
- Guha P. C. and P. R. Gupta. Studies in Synthetic Antimalarials: Some N4—Biguanido-benzene-N1. 2-pyrazinyl-sulphonamides III, 84.
- Guha P. C., J. R. Iyengar and S. C. Bhattacharyya. Thio-ureas of Sulphones and Sulphides, III, 90.
- Guha P. C., G. S. Krishan Rao and Sukh Dev. A study of the Essential Oil from the Oleo-resin of *Dipterocarpus Indicus*, III, 91.
- Guha P. C., B. N. Jayasimha and S. C. Bhattacharyya. Some derivatives of 4:4'-Diaminodiphenyl sulphone, III, 91.
- Guha P. C. and S. S. Guha. Isolation of ingredient compounds from Anthracene Oil, III, 123.
- Guha P. C., G. S. Krishna Rao and Dev Sukh. A study of the Essential Oil from wood of *Cedrus Deodara*, III, 91.
- Guha P. C. and L. Neelakantan. Studies in Antimalarials, Part VIII. Bisamidino Sulphides, III, 89.
- Guha P. C. and L. Neelakantan. Studies in Antimalarials, Part VII. N-Substituted 2:6-diphenyl pyridones, III, 89.
- Guha P. C., J. R. Iyengar and S. C. Bhattacharyya. Azo-dyes of 4:4'-diamino-diphenyl sulphone, III, 90.
- Guha, S. K., B. Banerjee, and Gurdas Ram. A preliminary Vibration on the Khadakwasla dam (Poona, India), III, 252.
- Guha S. S. and P. C. Guha. Preparation of Amines: Simultaneous Hydrogenation and Ammonolysis of Ketones, III, 87.
- Guha S. S., S. K. Deb and P. C. Guha. Studies in Antimalarials, Part III, Some aryl and alkyl carbo-diguanidines, III, 87.
- Guha S. S., S. N. Sur and P. C. Guha. Studies in Antimalarials, Part IV. Some aryl and alkyl sulphuryl diguanidines, III, 88.
- Guha, S. S. and P. C. Guha. Isolation of ingredient compounds from Anthracene Oil, III, 123.
- Gupta A. and N. C. Sen Gupta. Chromatographic analysis of natural Petroleum, III, 157 & 158.
- Gupta, Asoka, Sintering of Electrolytic Copper Powder Compacts, III, 238.
- Gupta, B. Pharmacognosy of India Ephedras, III, 19.
- Gupta, M. G., D. R. Dhingra and Girish C. Joshi. Studies in the preparation of Photographic Printing Papers, III, 144.
- Gupta, M. G. and D. R. Dhingra. A New Process for the Preparation of Chemical Gold-thread, III, 143.
- Gupta, M. G. and D. R. Dhingra. Studies in the Preparation of Photographic Plates, III, 142.
- Gupta, F. R. and P. C. Guha, Studies in Quinolyl—biguanides, III, 86.
- Gupta, P. R. and P. C. Guha. Studies in Synthetic Antimalarials: Some N4-Biguanido-benzene-N1. 2-pyrazinyl-sulphonamides, III, 84.
- Gupta, P. R. and P. C. Guha. Preparation of Isopropylidene-dimalonic ester, III, 84.
- Gupta, S. K. and S. C. Ghosal. Isolation of *V. Chelerae* from house flies from a Cholera Ward, III, 204.
- Gurubasavaraj, H. and N. P. Datta. Phosphate fertilization of Berseem (*Trifolium*) influence of boron and Molybdenum, III, 300.
- Gyani, B. P. and A. P. B. Sinha. Adsorption by Alumina Gel, III, 77.
- Gyani, B. P. and S. N. Das. Thermodynamics of Evaporation of Liquids, Part II, III, 77.

H

- Hafeeu, M. A., An experimental study of Telepathy and Clairvoyance. III, 279.
- Hafeez, M. A., A Study of Cattle's Disposition Test. III, 280.
- Haidar, S. Z. and S. D. Agarwala, *Precis orithya* as a controlling agent for *Striga euphrasioides*; a root parasitic weed on sugarcane. III, 306.
- Hasan Hamadul and Saidyid Shamim Ahmad. Resonating Semipolar Single Bond Part VII Reactions of the Double Bond (Olefines). III, 165.
- Hasan Hameedul and S. Shamim Ahmad. Resonating Semipolar Single Bond Part VI Molecular Rearrangements. III, 165.
- Hasan, S. Zafar and Kali Prasad, Tension among the students of the Lucknow University. III, 287.
- Hassan, M. Z. and S. L. Bharna, Comparative efficacy of Agroxone & Phenoxyline 30 as a Weed-Killer. III, 291.
- Hawkins, Philip A., H. N. Ray and G. A. Shivani. Preliminary observations on splenectomy and piroplasmosis in cattle, III, 198.
- Hazeri, Anandi, Influence of the Group upon Mental work, III, 279.
- Hazrah, Hareram, Need of Psychological Test in the field of Indian Education III, 287.
- Hota, A. K., K. S. Viswanathan and G. Patra. Occurrence of Irreversible Joshi Effect in Hydrogen. III, 221.
- Hota, A. K., K. S. Viswanathan and G. Patra. Influence of temperature and pressure on irreversible Joshi-Effect in nitrogen in the hysteresis range below the threshold potential. III, 61.
- Husain S. and V. S. Subrahmanyam. Potentiometric Estimation of Cobalt and Nickel. III, 157 & 158.
- Husaini S. M. and S. L. Saletore. Effect of Metals on Rancidity. III, 136.
- Hussain, W., B. Sahai and N. D. Kehar, Studies on tree leaves as fodder. III, 269.
- Hussain, W., B. Sahai and N. D. Kehar, Studies on tree leaves as fodder. III, 269.
- Hussain, W., B. Sahai and N. D. Kehar, Studies on tree leaves as fodder, VIII. Bargad (*Ficus bengalensis*) leaves as cattle fodder, III, 270.
- Hussain, W., B. Sahai and N. D. Kehar, Studies on tree leaves as fodder. IX Bargad (*Ficus bengalensis*) leaves as fodder for goats. III, 270.

I

- Indra, M. K. Formation of Aggregates in Dilute Suspension of Hydrogen Clay Systems. III, 78.
- Ingle, T. R. and B. V. Bhide. Investigation of the mucilage from *Talimkhana*. (N. O. *Asteracantha Longi folia*). III, 109.
- Ingle, T. R. and B. V. Bhide. Nitration of benzo- γ -pyrone. III, 109.
- Ingle, T. R. and B. V. Bhide. The structure of the mucilage from the seeds of *Tulsi*. (N. O. *Ocimum Sanctum Lina*). Part I. Study of Products of hydrolysis. III, 110.
- Ingl T, R. and B. V. Bhide. The structure of the gum from Drum-stick plant, i.e. *Moringa Pterygosperma*. (N. O. *Moringeae*). Part I. Chemical investigation of the gum. III, 109.
- Iyengar, J. R., S. C. Bhattacharyya and P. C. Guha. Thio-ureas of Sulphones and Sulphides. III, 90.
- Iyengar, J. R., S. C. Bhattacharyya and P. C. Guha. Azo-dyes of 4:4' diamino-diphenyl sulphone. III, 90.
- Iyengar, M. S., B. S. Narayan Rao and R. Vaidyeswaran. Influence of Controlled Oxidation of Non-Caking Indian Coal on the products of Low Temperature Carbonisation. III, 237.

- Iyengar, M. S. and B. S. Narayan Rao, Alcohol Petrol Blends as Fuels in I. G. Engine.
- Iyer, B. H. and M. V. Kowjalgi. Condensation of Methone with some Primary Aromatic Amines, III, 84.
- Iyer, S. G. Egg production in different breed of poultry. III, 199.
- Iyer, S. G. Hatchability in different breeds of fowls. III, 200.
- Iyer, S. G., Thakral B. M. and Narayanan S. The role of turning in relation to hatchability. III, 200.
- Iyer, S. G. Growth rate in purebred and crossbre fowls. III, 201.
- Iyer, S. G., B. M. Thakral and S. Narayanan. Inheritance of Smut (Slaty) under colour in Rhode Island Red, III, 201.
- Iyer, S. G. and H. P. Tandon. The influence of age of eggs on hatchability. III, 200.

J

- Jacob, E. John and T. A. Ramakrishnan, Travancore Merine Oils-Green Turtle Oil. Deodorisation of Turtle Oil. Part I. Selective Hydrogenation. III, 142.
- Jacob, E. John and T. A. Ramakrishnan, Part II. Effect of gallic derivatives on the development of rancidity of Turtle Oil. III, 141.
- Jacob, E. John and T. A. Ramakrishnan, Travancore Marine Oils: Green Turtle Oil, Part I. Effect of certain phenolic substance on the stability of Turtle Oil. III, 141.
- Jacob, Joseph. Is *Melanoides tuberculatus* (Muller) parthenogenetic? III, 325.
- Jadar, D. P. and G. M. Pandit. Study of Joshi Effect in H₂ in a Siemens' Ozoniser Discharge: Influence of Splitting the L. T. Electrodes in (a) Earthed and (b) Floating Segments, III, 222.
- Jadhav G. V., R. N. Usgaonkar and R. C. Saha. Pechmann Condensation of some 2:5-Disubstituted Phenols, III, 93.
- Jadhav G. V., V. G. Kulkarni, Studies in Chalkone derivatives—Study of the rectivity of the chalkone dibromides, III, 94.
- Jain, M. L., Communication in Direct Current Mechines, III, 250.
- Jain, Magina Lal, Baldev Singh Bhatia and Girdhari Lal, Canning of curried vegetables, III, 302.
- Jain, N. L., D. P. Das and Girdhari Lal, Utilization of waste lime pulp, III, 305.
- Jain, N. L., D. P. Das and Kirdhari Lal, Prelimanry observation on the packing of orange juice, III, 304.
- Jalota, S., A Tachistoscope for paired comparisons, III, 277.
- Jatar, D. P. and G. M. Pandit. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge, III, 217.
- Jatar, D. P. and G. M. Pandit. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge, III, 217.
- Jatar, D. P. and G. M. Pandit. Studies of Negative Joshi Effect in Hydrogen Discharge with Metallic Electrodes: Influence of the Gas Pressure and Applied Potential, III, 221.
- Jatkar, S. K. K. and V. K. Phansalkar. Vibration, Rotation Spectra of Molecules, III, 212.
- Jatkar S. K. K. and C. M. Deshpande. Induction, Dipole Moments and Infra Red Spectra, III, 72.
- Jawa, S. S., D. P. Mukherjee and P. Bhattacharyya, Seasonal Variation in the Rate of Respiration, Pulse Rate and Body Temperature of different age groups of Hariana Cattle, III, 265.
- Jayasimha B. N., S. C. Bhattacharyya and P. C. Guha. Some derivatives of 4:4'-Diaminodiphenyl sulphone, III, 91.

- Johari, M. P., D. P. Mukherjee and P. Bhattacharyya, Effect of the Intra Vaginal Administration of the Gel Mass of Rabbit Semen on the Reproductive organs of the Female Rabbit, III, 265.
- Johri, B. M. Abnormal medullary bundles in the stem of *Argyrei, speciosa*, III, 28.
- Johri, Endosperm and embryo development in *Acalypha indica* L., III, 24.
- Johri, L. N., On a morphological study of the genital organs in *Hymenolepis farcinisa* (Goeze 1782), III, 316.
- Johri, L. N., On a new species of the family Hymenol epididae Fuhrmann (Cestoda) from *Cournix coturnir* (Linnaeus) from Delhi Province, III, 317.
- Johry, K. N. and L. N. Srivastava. Formation of complex compounds between alkali nitrates and alkaline earth nitrates, III, 52.
- Joneja, K. L., P. B. Bhattacharyya and K. L. Khanna, Studies of the Activity of Manganese in Calcareous Soils, III, 296.
- Joseph P. T. Zirconium tetrachloride in Organic Synthesis, III, 112.
- Joshi Girish C., D. R. Dhingra and M. G. Gupta. Studies in the preparation of Photographic Printing Papers, III, 144.
- Joshi K. C. and A. B. Sen. Fungicidal Activity of some esters of Cresotinic Esters. Organic Fungicides: Part VI, III, 108.
- Joshi K. C. and A. B. Sen. Organic Fungicides: Part V. Fungicidal Activity of some Dibromoacetamides, III, 107.
- Joshi K. M. and A. N. Kappanna. Alternating Current Electrolysis—Part I. Oxidation of Glucose, III, 74.
- Joshi M. A. and C. R. Talapade, Utilisation of Sambhar Lake Bitterns, III, 139.
- Joshi, R. V. Urban Structure in Western India: Poona, a sample study, III, 187.
- Joshi, R. V. A Study of the Malaprabha River Basin with special reference to the Palaeolithic Sites, III, 185.

K

- Kabi, T. and B. Samantarai. Studies in the rooted leaves of *ipomoea batatas*, Lamk. III, 26.
- Kacker, I. K. and S. H. Zaheer. Syntheses of Quinazolinols. III, 102.
- Kaimal, T. K. P., C. J. Philip and P. G. N. Pillay, Studies in the Tube Well Waters in the Coastal Areas of Travancore. Part I. "The Tube Wells at Veli," III, 142.
- Kaimal T. K. P., C. J. Philip and P. G. N. Pillay, Studies in the tube well water in the coastal areas of Travancore, Part I. Tube well at Veli. III, 140.
- Kakaji, T. N. and A. B. Sen. Synthesis of some Hydroxy Ketones. III, 106.
- Kamath, Miss H. Sunanda and C. Rajasekhara Mudaliar. Distribution of *Rhizophora mucronata* Lam., in the 'Back-waters' of the Coast and its Economic importance. III, 20.
- Kanitkar, U. K. and M. K. Moolani, Differential response of *Cicer Arientinum*, L. To treatment of seed with Ethyl Ester and Sodium Salt of 2,4-D. III, 292.
- Kanitkar, U. K. and S. S. Patil, Activation of growth of seedlings of wheat by treatment of seed with 2,4-Dichlorophenoxy acetic Acid, III, 292.
- Kanitkar, U. K. and V. K. Deshmukh, Imbibition of water by seed of Jowar Varieties. III, 291
- Kapadia, V. H. and N. G. Magar. Effect of Butylated Hydroxy Anisole on the Stability of Oils and Hydrogenated Fats. III, 92.
- Kapadnis, D. G. The Effect of Fluid Motion on Head Transmission. III, 210.
- Kapil Y. P. and S. Mukherjee. Sugar Cane-wax. Part I. Its purification and properties. III, 145.

- Kapoor, B. G., On the functional morphology of the alimentary canal of *Wallago attu* (Bl. & Schn.) a siluroid fish, in relation to its feeding habits: *Anatomy and Histology*. III, 332.
- Kapoor, H. P., C. M. Singh and A. Roy, Haematological Normals of Buffaloes, III, 265.
- Kapoor, B. R. and T. N. Mehta, Extraction of Protein from Mustard Seed Oil Cake, III, 149.
- Kappanna, A. N. and K. M. Joshi, Alternating Current Electrolysis Part I. Oxidation of Glucose. III, 74.
- Kapur, A. P. and D. K. Dutta, Studies on the bionomics of the semi-aquatic Grasshopper *Gesonula punctifrons* Stoll. III, 339.
- Kar, Amiya B. and Asok Ghosh, Seasonal Periodicity in the Grounds of the Common Indian Catfish *Heteropneustes fossilis* (Bloch), III, 275.
- Kar, B. K. and B. K. Dey Sarkar, Physiology of Fibre Growth in Jute (*Corchorus*). III, 293.
- Kar, P. and Uday N. Sarkar, Petrogeometric interpretation of a crushed conglomerate from Rannamatia, Singhbhum Dist. Bihar. III, 189.
- Karan, P. P. Study in City Growth and Morphology. III, 186.
- Karve, D. D., K. K. Dole and B. W. Kelkar, Adsorption of dyes on metallic surfaces. Part VII. III, 73.
- Kasisastri, V. and V. Narasimhamurti, Equilibrium Exchange Rate of the Rupee. III, 17.
- Kasisastri, V. and V. Narasimhamurti, Distribution of Income in India. III, 17.
- Kasturi Ranjan L., N. K. Saha and M. Choudhury, Absolute Neutron Flux from a Ra Be Neutron Source. III, 228.
- Kehar, N. D. and S. S. Negi, Investigations on subsidiary Feeds: Mangrove (*Avicennia officinalis* Linn.) leaves as feed for cattle. III, 268.
- Kehar, N. D., S. N. Ray, and K. Sahai, Investigation on the optimum level of fat in the ration of ruminants, III, 267.
- Kehar, N. D. and V. N. Murthy, The iron requirement of sheep, III, 263.
- Kehar, N. D., W. Hussain and B. Sahai, Studies on tree Leaves as fodder. III, 269.
- Kehar, N. D., P. C. Sawhney and A. N. Bahl, Studies on Protein, Calcium and phosphorus metabolism in growing lambs, III, 266.
- Kehar, N. D., W. Hussain and B. Sahai, Studies on tree leaves as fodder. VIII. Bargad (*Ficus bengalensis*) leaves as cattle fodder. III, 270.
- Kehar, N. D., P. C. Sawhney and A. N. Bahl, Studies on Protein, calcium and phosphorus metabolism in growing lambs. III, 266.
- Kehar, N. D. and V. N. Murthy, Studies on Graminae crops. III, 268.
- Kehar, N. D. and V. N. Murthy, Iron content of animal feeds. III, 269.
- Kehar, N. D. and I. Kumar, Investigations on silage making Lucerne and Paddy straw silage as feed for cattle. III, 267.
- Kehar, N. D., P. C. Sawhney and A. N. Bahl, Blood studies in lambs on different levels of protein intake. III, 265.
- Kehar, N. D., W. Hussain and B. Sahai, Studies on tree leaves as fodder. IX Bargad (*Ficus bengalensis*) leaves as fodder for goats. III, 270.
- Kehar, N. D. and D. N. mullick, Energy metabolism in cattle, III, 266.
- Kelkar B. W., Karve D. D. and K. K. Dole, Adsorption of dyes on metallic surfaces. Part VII. III, 73.
- Kelkar, S. V. and A. P. Saxena, Joshi Effect in Fluorescent Tubes. III, 214.
- Khambata, F. S. and D. V. Bal, Four new species of the genus *Acanthobothrium* from Marine Fishes of Bombay. III, 316.
- Khan, H. A. and D. S. Datar, Further study on mechanism of adsorption on active charcoal. III, 66.

- Khan H. A. and D. S. Datar. Activated Charcoal from Groundnut Hulls: use of Zinc Chloride as an Activating Agent. III, 137.
- Khan, H. A. and D. S. Datar. Activated Charcoal from Ground Nut Hulls: Use of Ferric Chloride as activating Agent. III, 137.
- Khanna, K. L. and A. S. Chachravarti, Studies in gur quality in Bihar 1. III, 303.
- Khanna, K. L., A. S. Chachravarti, Satrugan Prasad, Durga Prasad Srivastava Studies in storage of gur, III, III, 304.
- Khanna, K. L., P. B. Bhattacharyya and K. L. Joneja, Studies of the Activity of Manganese in Calcareous Soils, III, 296.
- Khanna, K. L., K. B. Sharma and K. S. Bandyopadhyay, On the classification of Wheat samples, III, 289.
- Khanna, K. L., S. C. Sen and K. S. Bandyopadhyay, On the prediction of Sugar Recovery, III, 289.
- Khanna, Prabha, Social Relations in an Indian town, III, 282.
- Khare K. N., B. M. Shukla and A. Upadhyaya. Production of Joshi effect in a Topler Evacuated Ozoniser in presence of Mercuric Iodide. III, 62.
- Khare, K. N., B. M. Shukla and P. K. Tikoo. Role of Surface Contamination by Metallic Powders (Al and Zn) in the Production of Joshi Effect. III, 216.
- Khare, K. N., B. M. Shukla and P. K. Tikoo. Role of Surface Contamination by Metallic Powders (Al and Zn) in the production of Joshi Effect. III, 216.
- Khare M. P. and V. S. Misra. Chemotherapy in Tuberculosis Preparation of Acyl-Diphenyl-Amidines. Part I, III, 108.
- Khastgir, S. R. and B. A. P. Tantry. Atmospherics Recorder, III, 227.
- Khastgir, S. R. and R. Sankaran. Dielectric Properties of Salt Solutions in the Range of Ultra-High Frequencies (230-330 Mc/s.), III, 226.
- Khastgir, S. R., R. Satyanarayana and K. Ranadas, Study of the Polarization of the Downcoming Wireless Waves of Medium Wavelengths. III, 227.
- Kilpady, Sripadrao. A Giant Pelecypod from the Cretaceous Rocks of Trichinopoly, III, 180.
- Koley K. P. and M. N. Goswami. Production of Acetone from Ethyl Alcohol in one step process. III, 129.
- Koley K. P. and M. N. Goswami, Investigation on the production of High-octane Aviation Fuels, Decanes and Octanes, III, 130.
- Kowjalgi M. V. and B. H. Iyer. Condensation of Methone with some Primary Aromatic Amines, III, 84.
- Krishnaswami S. F., Atma Ram, P. Roy and Y. P. Varshney. On Glass Bottles suitable for containing inks, III, 127.
- Krishnaswami, V. D., N. R. Banerjee and K. V. Sundarajan. The Microlithic Industry of Tinnevely, III, 45.
- of closely lying areas, III, 301.
- Kulkarni, Nagesh R. and B. R. Marathe. Studies of Joshi Effect in a Discharge Tube with Plane Parallel Electrodes Placed Externally Contact with the Tube: (a) Pressure Variation of H₂ (b) Length and Diameter Variation of the Tube, III, 223.
- Kulkarni P. S. and K. K. Dole. Investigations in Viscosities of Milks. III, 72.
- Kulkarni V. G. and G. V. Jadhav. Studies in Chalkone derivatives. Study of the reactivity of the chalkone dibromides; III, 94.
- Kumar, G. D. and B. K. Chatterjee. Proportion of the upper and the lower extremities of the body of the hill tribes of Travancore and Cochin, III, 44.
- Kumar, G. D. and B. K. Chatterjee, Relation between Stature and Sitting height of the different hill tribes of South Western extremity of Indian Peninsula, III, 43.

- Kumar, G. D. and B. K. Chatterjee. Relation of stature, girth of chest and the weight of body of different hill tribes of Travancore and Cochin States, III, 44.
- Kumar, I. and N. D. Kehar, Investigations on Silage making, Lucerne and Paddy straw silage as feed for cattle, III, 267.
- Kundu, A. K., T. N. Ghosh and A. Ray Choudhuri, Search for New Antispasmodics, Part IV. III, 96.
- Kundu Nakuleswar and Priyadarajan Ray. Transformation of Biguanide into Dicycndiamidines, III, 100.
- Kundu Nakuleswar. The synthesis of some organic compounds of gold with long chain fatty acids. III, 99.
- Kuppuswami, B., Basic preparation for an Honours Course in Psychology, III, 227.
- Kuppuswamy, B., Measurement of social distance, III, 282.
- Kuppaswamy, B., Comparison of two opinion surveys regarding the formation of linguistic states, III, 282.
- Kuppuswamy, S., G. Rama Rao, Saranya Kumari Reddy and M. Swaminath, Biological value of Proteins of synthetic grains from Tapioca and Groundnut Flour, III, 274.
- Kuriakose, J. C. and Lourdu M. Yeddapanalli. Catalytic Cracking of the Monophenol from Raw Commercial Cashewnut Shell Liquid: Preliminary Investigation. III, 75.
- Kuriyan, G. K., A note on the parasitic Isopod, *Cymothosa eremita* Bruennich, III, 319.
- Kuriyan, G. K. and K. Chidambaram, Certain observations on the bionomics and fishery of the Big-jawed Jumper *Lactarius Lactarius* Cuv. and Val., III, 327.
- Kuriyan, G. K. and K. Chidambaram, The fluctuation of the blue green algae *Trichodesmium erythraeum* Ehrenb, in the plankton off Krusadai Island, Gulf of Mannar, III, 338.

L

- La, G. S., J. S. Rawat and A. Roy, Normal values of some Chemical Constituents of Buffalo Blood, III, 263.
- Lakhanpal, R. N. Some Angiospermic Plant Remains from the Tertiary beds of the Garo Hills, Assam, III, 32.
- Lal, Girdhari, N. L. Jain and D. P. Das, Utilization of waste lime pulp, III, 305.
- Lal, Girdhari, Magina Lal Jain, and Baldev Singh Bhatia, Canning of curried vegetables, III, 302.
- Lal, Kirdhari, N. L. Jain and D. P. Das, Preliminary observation on the packing of orange juice, III, 304.
- Laud, B. B. and N. R. Tawde. Role of the Method of Numerical Integration in the Band Intensity Theories. III, 214.
- Laul (Miss) K. S. and M. C. Nath. The production of Acetone bodies by E. Coil. III, 120.
- List of Delegates. I, 17.
- Lieb, H. and W. Schoeniger. A new Volumetrical Method for the Determination of Co-Groups in the Micro Scale. III, 161 & 162.
- Local Reception Committees. I, 14.
- Luktuke, S. N., S. Guha and P. Bhattacharya. Effect of administration of Gonadotrophic Hormones on Semen quality. III, 264.
- Luktuke, S. N. and P. Bhattacharya. Effect of Pregnant mare Serum Gonadotrophic (PMS) on anoestrous Buffalo. III, 198.

- Luktuke, S. N. and P. Bhattacharya, Studies on reducing substances of Semen: Fructolysis in Semen and relation of Soerm concentration to Fructose content, Sement volume and fructolysis. III, 264.

M

- Madhok, M. R. and Lakh Raj Dhingra, Losses of Nitrogen from Urine under different conditions, III, 297.
- Magar, N. G. and V. H. Kapadia. Effect of Butylated Fats. III, 92.
- Mahadevan, C. and U. Aswathanarayana. Distribution of Radioactivity at different levels from K. G. F. Mines. III, 172.
- Mahadevan, C. and N. V. A. S. Perumal. Manganiferous rocks and their associates in East Chipurupalie Area, Visakhapatnam District. III, 173.
- Mahadevan, C. and B. Kukkuteswara Rao. Some observations on the interaction of Eastern Ghat rockhsuites in Visakhapatnam District. III, 173.
- Mahadevan, C. and B. Kukkuteswara Rao. Some observations on the interaction of Eastern Ghat rockhsuites in Visakhapatnam District. III, 173.
- Mahadevan, C. and P. Satyanarayan Rao. The Geology of the Manganese-bearing Rocks of Rayagada, Koraput District, Orissa. III, 174.
- Mahadevan, C. and S. N. Visvanath. Aspects of the Zonal Theory of Oredposition in the Kolar Gold Fields. III, 184.
- Mahadevan, C. and K. Suryanarayana. Correlation of some Coastal Gondwanas in Parts of Guntur and Nellore Districts. III, 182.
- Mahadevan, C. and P. Perraju. Geology of Yellamanchill Area. III, 183.
- Mahadevan, C. and A. Sriramadas. A Heavy Mineral Correlation of the Sedimentaries of East Godavary and Visakhapatnam Districts. III, 183.
- Mahadevan, C. and J. S. R. Krishna Rao. Manganese garnets from Chipurupalle Area, Vizagapatam District. III, 170.
- Mahadevan, C., B. J. N. S. R. Anjaneyulu and Y. Bala Sankaram. Black Sand concentrates alongg the beach in South Visakhapatnam District. III, 171.
- Mahadevan, C. and N. Sathapathi. Optical properties of the micas from Visakhapatnam. III, 169.
- Mahadevan, C. and R. Rangayya. Geolgy of N. W. parts of the Nellore District with special reference to origin of copper and barite. III, 171.
- Mahadevan, C. and C. Borreswara Rao. Genesos of Steatite in Mutchukota Area. III, 171.
- Mahadevan, P. S. and C. S. Bhaskaran Nair, Fosils of Kuttanad. III, 141.
- Mahadevan, C. and S. N. Visvanath. On the Colour of Blue Quarts. III, 170.
- Mahadevan, T. D., S. Bose, A. K. Pal and R. Narain. The determination of quality in eggs, based upon the physical and chemical characteristics of the eggs. III, 202.
- Mahajan, L. D. Effect of Humidity on Human Hair. III, 209.
- Mahapatra, L., N. Patnaik and B. Ray Burman. A Note of christian oraons in sundargarh: district, Orrissa. III, 45.
- Mahmood, S. Hamid, Structure of gnathal appendages and their role in the mode of aleurololus barodensis M., III, 320.
- Majumdar, Girija Prosanna and Sudhir Kumar Banerji. The origin and development of the shoot apex in Iycopodium phlegmaria. L., III, 40.
- Majumdar, Nandagopal, A Note on the Apparent Disappearance the Theory of Expanding Universe. III, 229.
- Majumdar, N. N., On specimens of Wallago attu (Bl. and Schn.) with two pairs of Wallago attu (Bl. and Sch.) with two pairs of mandibular barbels. III, 323.

- Majumdar, N. N., On the anatomy and histology of the palate of *Cirrphina mrigala* (Ham.), with special reference to the papillae present on it together with comments on their possible respiratory function. III, 330.
- Majumdar, N. N., On the occurrence of subcutaneous mandibular barbels in *Silonia* (Ham.), III, 331.
- Majumdar, S. C., Atma Ram, K. D. Sharma and Y. P. Varshney. *Utilonia* (Ham.), III, 331.
- Majumdar, S. C., Atma Ram, K. D. Sharma and Y. P. Varshney. Utilisation of salt cake in the Indian Glass Industry. III, 127.
- Majumdar, Subodh Kumar, Electron Diffraction of Some Crystals. III, 230.
- Mallik, N. and S. C. Sen, Effect of lodging and tillering at the Epical Region of the stem on Juice quality of Sugarcane Crops. III, 294.
- Mandal, S. C. and H. N. Mukherjee, Studies in the reaction of Bihar Soils L Fluctuation in acidity and lime requirement of soils. III, 298.
- Mandal, S. C. and H. N. Mukherjee, Problems in the reclamation of waste lands in Hihar. I. Improvement of Leached Acid Sandy Soils. III, 299.
- Madan, M. P. and B. N. Srivastava. Intermolecular Fore and Coefficient of Self-Diffusion. III, 209.
- Mandan, Sahib Ram., A set of Eight Associated Points. III, 5.
- Mandan, Sahib Ram., Shortest Distance. III, 5.
- Mann, K. H. and M. L. Bhatia, *Haemopsis sanguisuga* Linnaeus, the common European *Ahynchoodellid* Leech compared with *Haemopsis indicus* Bhatia, the Indian form of Kashmir, III, 317.
- Marathe, B. R. and R. J. Galagali. Invesigation of Joshi Effect in Geissler Tube under D. C. Excitation. III, 220.
- Mathematics: Some Recent Methods for Solving Problems of Equilibrium and Vibration—Dr. B. B. Sen, II, 33.
- Marathe, B. R. and R. J. Galagali. Joshi Effect in H₂ Using a Discharge Tube with External Plane Parallel Electrodes: Variation of the Dismeter of the Electrodes and Their Distance from the Tube. III, 222.
- Marathe, B. R. and R. J. Galagali. Studies of Joshi Effect under X-ray Irradiation. III, 224
- Marathe, B. R. and Nagesh R. Kulkarni. Studies of Joshi Effect in a Discharge Tube with Plane Parallel Electrodes Placed Externally Contact with the Tube: (a) Pressure Variation of H₂ (b) Length and Diameter Variation of the Tube. III, 223.
- Marathe, V. B. and P. W. Dideon, A preliminary survey of the fresh water plankton from some waters of the Bombay Karnatak, III, 338.
- Marie, (Miss) M. Jaja, Morpho-ecological studies into the thorns (= Spines of south Indian Plants-1, III, 20.
- Mathur, B. B. L., Syseematic notes on a collection of fishes from Rajputana, III, 333.
- Mathur, J. and T. L. Rama Ghar, Electrodeposition of Gadwium from Cyanide-Free Baths: Gadmium Sulphamate Solutions, III, 237.
- Mathur, S. B. L., The Thermionic Work Function of Iron, III, 230.
- Mazumdar, Girija Prosanna and Sudhir Kumar Banerji. The origin and development of the shoot apex in *Equisitum debile*. Roxb., III, 39.
- Mazumdar, R. B. and A. K. Ghosh. The Age of the Mandi Salt-Belt, III, 182.
- Medical & Veterinary Science: Etiology of Cancer—Dr. V. R. Khanolkar, II, 189.
- Meetings of Committee. I, 37.
- Meenakshi, V. R., The physiology of feeding and digestion in *Melania crenulata*.
- Mehrotra, R. R., V. D. Rajan and S. S. Banerjee. Long Distance Scattering of radio waves and undulations in the Ionospher, III, 251.

- Mehta, G. K. and N. R. Tawade. Effect of Pressure on the Excitation of Triplet and Singlet States in H₂ Spectrum, III, 213.
- Mehta, G. K. and N. R. Tawade. Spectroscopic Method for Determination of Electron Energy in Discharge, III, 213.
- Mehta, T. N., C. V. N. Rao and P. Sen. Behaviour of certain edible oils in the Frying Pan, III, 148.
- Mehta T. N. and B. R. Kapoor. Extraction of protein from Mustard Seed Oil Cake, III, 149.
- Menon, P. Balarama, B. C. Basu and C. M. Sengupta, Studies on the bionomics of *Tabanus* flies in the field with a view to work out control measures, III, 322.
- Menon, P. Balarama, B. C. Basu and C. M. Sengupta, Cases of myiasis in man due to *Oestrus ovis linnaeus* (sheep bot), III, 322.
- Menon, P. Balarama, B. C. Basu and C. M. Sengupta, Distribution of *Tabanus* flies in India and the adjacent countries, III, 323.
- Mishra D. Refining of shaal seed fat, III, 147.
- Misra, A. N. and B. N. Pramanik, The effect of continuous manuring with Nitrogenous, phosphatic and potassic fertilizers on the population of *Azotobacter Chroococum* and on total bacteria in the soil, III, 296.
- Misra, G., and B. Samantarai. Rooting Response of Tropical Leaves, III, 26.
- Misra Jagadish, A. C. Chatterjee and A. N. Bose. A study of Viscosity of the System Na-Oleate-Water and Butyl Alcohol in Presence of NaCl, III, 68.
- Misra V. S. and M. P. Khare. Chemotherapy in Tuberculosis Preparation of Acyl-Diphenyl-Amidines, Part I, III, 108.
- Mitra, B. N., H. K. Mukherjee and D. N. Ganguly, Preliminary observation on the Distribution fry collection centres, method of collection and the fry trade in the river Bhagirathi of West Bengal, III, 328.
- Mitra, D. K. and S. K. Mukherjee. Measurement of cation activity by the use of clay membrane electrodes, III, 63.
- Mitra, D. N. Flexure of an isotropic elastic cylinder whose cross-section is bounded by two closed curves, III, 12.
- Mitra, G. C. The Origin and Development of Vegetative Axillary Buds in Dicotyledons, III, 27.
- Mitra, J. N. and Bhattachariya, S. S. Development of Memale Gametophyte in *Triumfeta rhomboidea* Jacq., III, 24.
- Mitra, K., S. Chaudhuri and S. Swaroop, Haematologica and biochemical studies in normal adult women of nursing profession, III, 254.
- Mitra, S. K., Anti-Muslim attitude of a group of Bengali and Bihar boys, III, 283.
- Mitra, S. N. Studies on the Rancidity of Butter-fat (ghee)—Part II. III, 131.
- Mitra S. N. Studies on the development of Rancidity in Butter-fat (Ghee), Part I. III, 133.
- M. N., R. N. Chaudhuri and B. N. Dutta. Clinical trial M-5043 (A new Chloro-Derivative of Paludrine), III, 205.
- Modak, G. K. Some new Fossils from the Baripada Beds. Mayurbhanj, Orissa, III, 180.
- Moghni, S. M., The female sex in Indian culture, III, 285.
- Moghni, S. M., Psychology of the female sex, III, 284.
- Mohan, R. G. and Lourdu M. Yeddanapalli. Kinetics and Reaction Mechanism of Alkali Catalysed Reaction between Phenol and Formaldehyde: Part II. III, 74.
- Mohanty, S. C., S. R. Mohanty and Ch. B. N. Nanda. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures, III, 218.
- Mohanty, S. R., S. C. Mohanty and B. N. Nanda. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures, III, 218.

- Mohanty, S. C., S. R. Mohanty and B. N. Nanda. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures, III, 218.
- Mohanty, S. R., Ch. B. N. Nanda and S. C. Mohanty. Comparative Studies of the Joshi Effect in Stationary and Flowing Oxygen, III, 218.
- Mohanty, S. R., S. C. Mohanty and Ch. B. N. Nanda. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures, III, 218.
- Mohanty, S. C., S. R. Mohanty and Ch. B. N. Nanda. Comparative Studies of the Joshi Effect in Stationary and Flowing Oxygen, III, 218.
- Mookerjee, B., H. K. Mookerjee and D. N. Ganguly, The development of the vertebrate column in *Anguilla japonica*, III, 328.
- Mookerjee, H. K., D. N. Ganguly and S. K. Brahma, On the life history of *Barbus stigma* (Cux & Val), III, 328.
- Mookerjee, H. K., D. N. Ganguly and B. Mookerjee, The development of the vertebrate column in *Anguilla japonica*, III, 328.
- Mookerjee, H. K., D. N. Ganguly and Miss Gouri Ghosh, The formation of synovial activity in different joints of the skeletal system of the Vertebrates, III, 326.
- Mookerjee, H. K., D. N. Ganguly and B. N. Mitra, Preliminary observation on the distribution fry collection centres, method of collection and the fry trade in the river Bhagirathi of West Bengal, III, 328.
- Mookerjee, H. K., D. N. Ganguly and P. S. Mookerjee, On the biological productivity of a typical brackish water Tarn (Bheri) of lower Bengal, III, 338.
- Mookerjee, P. S., H. K. Mookerjee and D. N. Ganguly, On the biological productivity of the typical brackish water Tarn (Bheri) of lower Bengal, III, 338.
- Mookerjee, Sivatosh, Thermal exposure to isolated ectoderm cells of amphibian gastrula, III, 334.
- Moolani, M. K. and U. K. Kanitkar, Differential response of *Cicer Arientinum*, L. To treatment of seed with Ethyl Ester and Sodium Salt of 2,4-D, III, 292.
- Moorthy K. N. and D. S. Datar. A new method for the preparation of ferrous Sulphaate from iron Pyrites, III, 136.
- Moorthy K. N. and D. S. Datar. A method for obtaining pure precipitated manganese dioxide from Pyrolusite, III, 137.
- Moorthy, K. N. and D. S. Datar. Preparation of Iron Sulphate from Coal Pyrites, III, 136.
- Mukherjee, M. K. J. N. Chakraborty and G. S. Roy, Soils of Damodar Valley. I : Soils of Barhi area: Relation between clay content and nutrient status of of closely lying areas, III, 301.
- Mudaliar, C. Rajasekhara and Miss H. Sunanda Kamath, Distribution of *Rhizophora mucronata*, Lam., in the 'Back-water' of the coast and its Economic importance, III, 20.
- Mukherjee, Ajit Kumar and Priyada Ranjan Ray. Inner-Metallic Complex Salts of Sulphanilamide-Salicylaldehyde and its Derivative, III, 49.
- Mukherjee Asoke Kumar. Concentration and Viscosity of Dilute Solutions, III, 63.
- Mukherjee, D. P., M. P. Johari and P. Bhattacharyya, Effect of the Intra Vaginal Administration of the Gel Mass of Rabbit Semen on the Reproductive organs of the Female Rabbit, III, 265.
- Mukherjee, D. P., S. S. Jawa and P. Bhattacharyya, Seasonal Variation in the Rate of Respiration, Pulse Rate and Body Temperature of different age groups of Hariana Cattle, III, 265.
- Mukherjee, G. G., M. Sengupta and S. S. Banerjee, Effect of Undulations in the Mesosphere on the fading patterns, III, 252.
- Mukherjee, H. N. and S. C. Mandal, Problems in the reclamation of waste Lands in Bihar. I. Improvement of Leached Acid sandy soils, III, 299.

- Mukherjee, H. N. and S. C. Mandal, Studies in the reaction of Bihar Soils L. Fluctuation in acidity and lime requirement of soils, III, 298.
- Mukherjee, K. N. Telegus of Andhra Coast, III, 186.
- Mukherjee, K. N. and V. L. S. P. Rao. Agricultural Land,—productivity of West Bengal, III, 187.
- Mukherjee Lalmohon, Potentiometric Titration of Synthetic Organic Cation-Exchanging Resins in Mixed Medium, III, 159 and 160.
- Mukherjee, M. K., J. N. Chakraborty and G. S. Roy, Soils of Damodar Valley: III—Phosphate studies: Factors responsible for Fixation of Phosphates, III, 301.
- Mukherjee, Pasupati. Studies in Emulsions, III, 79.
- Mukherjee, P. C. and G. P. Chatterjee, Studies on the behaviour of Cu-Mg alloys against atmospheric Corrosion, III, 239.
- Mukherjee, R. K., Development of Flash Heam Generator in India, III, 232.
- Mukherjee S. and Y. P. Kapil. Sugar Cane-wax. Part I. Its purification and properties, III, 145.
- Mukherjee S. K. and S. K. Sinha. Measurement of ion activity by means of resin membrane electrodes, III, 62.
- Mukherjee S. and H. C. Srivastava. Structure of Neem (*Melia Azadirachta Indica*) Gum. part I, III, 114.
- Mukherjee S. K. and D. K. Mitra. Measurement of action activity by the use of clay membrane electrodes, III, 63.
- Mukherjee, S. K. and P. Nandi. Use of Sodium propionate in the isolation of soil actinomycete, III, 39.
- Mukherjee, Sunil Kumar. Vegetation of the Delhi Ridge, III, 21.
- Mukherjee S. N. and A. R. Ghosh. Electro-chemical Properties of Solutions of Yeast Nucleic Acid, III, 119.
- Mukerji, B. and S. C. Datta. Pharmacognosy of India Dark drugs, III, 41.
- Mullick, D. N. and N. D. Kehar, Energy metabolism in cattle, III, 266.
- Munshi N. K. and H. G. Biswas. An economic Isolation of Berberine from an Indian Souce. III, 132.
- Murthy, S. N. B. Graphical Solutions to Wave Interaction Problems in Gas Flow. III. III, 210.
- Murty, V. N. On a New Approach to the Analysis of Lattice Designs, III, 15.
- Murty, V. N. and N. D. Kehar, Iron content of animal feeds, III, 269.
- Murty, V. N. and N. D. Kehar, Studies on Graminae crops, III, 268.
- Murty, V. N. and N. D. Kehar, The iron requirement of sheep, III, 263.
- Muthu S. and S. K. Bhattacharyya. Studies on Polymerisation. Part I. Thermal Polymerisation of ethylent at high pressures. III, 121.
- Murthy, H. B. N., V. Subrahmanyam and M. Swaminathan, Effect of Partial Replacement of Rice or Wheat poor vegetarian Diets by Tuber Flours on the Nutritive Values of the Diets, III, 272.
- Murthy, H. B. N., V. Subrahmanyam and M. Swaminathan, The effect of partial replacement of rice in poor Rice diet by Tapioca on the Tetention of Nitrogeon, Calcium and Phosphorus in Human Subjects, III, 273.

N

- Nadkarni G. B. and V. A. Patwardhan. Fatty Oil from the seeds of *Cassia fistula*, Linn. III, 115.
- Naidu Bohan Babu, N. Bhojraj Naidu and S. A. Salefore. Studies on *Annona squamosa* (Linn.) seed (sitaphal), Part II: Its toxic Principle. III, 105.
- Naidu N. Bhojraj, Bohan Banu Naidu and S. A. Salefore. Studies on *Annona squamosa* (Linn.) seed (sitaphal), Part II: Its toxic Principle. III, 105.

- Naidu Mohan Babu, N. Bhojraj Naidu and S. A. Saletore. Studies on *Annona Squamosa* (Linn.) Seed (sitaphal). Part III. Detoxication of seed oil for edible purposes. III, 138.
- Naidu N. Bhojraj, Mohan Babu Naidu and S. A. Saletore. Studies on *Annona Squamosa* (Linn.) Seed (sitaphal). Part III. Detoxication of seed oil for edible purposes. III, 138.
- Naidu N. Bhojraj and S. A. Saletore. Economics of *Annona Squamosa* (Linn.) Seed Production in Hyderabad, III, 138.
- Naik, R. M. and Suresh Sethna. Bromination of 5-Hydroxy-2-methylchromone, III, 95.
- Nair, C. S. Bhaskaran and P. S. Mahadevan, Fossils of Kuttanand, III, 141.
- Nair, K. G. N. and N. S. Varier, Travancore Eucalyptus Oil, III, 140.
- Nanda, B. N., S. R. Mohanty and S. C. Mohanty. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures. III, 218.
- Nanda, J. N., Microcismis at Washington, D. C.
- Nanda, Ch. B. N., S. R. Mohanty and S. C. Mohanty. Comparative Studies of the Joshi Effect in Stationary and Flowing Oxygen. III, 218.
- Nanda, Ch. B. N., S. R. Mohanty and S. C. Mohanty. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures. III, 218.
- Nandi, D. K. and S. S. De, Vegetable milk from soyabean, groundnut and ragi, III, 261.
- Nandi, P., Miss C. Das Gupta and Miss S. Baruah., Selection of better strains of *Aspergillus niger* for the production of citric acid, III, 34.
- Nandi, P. and S. K. Mukherjee. Use of Sodium proprionate in the isolation of soil Actinomycetes, III, 39.
- Nandi, P. and S. Sen. Inhibition of Rhizobium and Azotobacter by Antibiotic Producing Soil Fungi, III, 39.
- Nandi, P. and Miss Preety Chakrabarty. Studies on the isolation of Azotobacter in several samples of cultivated soil, III, 38.
- Nandi, P., N. K. Chakraborty and P. Basu, Antibiotic activities of some micro organisms isolated from Bengal, III, 38.
- Narain, R., S. Bose, A. K. Pal, and T. D. Mahadevan. The determination of quality in eggs, based upon the physical and chemical characteristics of the eggs. III, 202.
- Narain, R. D. A Generalized class of sampling Procedures, III, 14.
- Narasimham M. D. and S. H. Zaheer. Investigations on Hyderabad Clays for making Fireclay Refractories, Part II. III, 137.
- Narasimhamurthy, V. and V. Kasisastri, Equilibrium Exchange Rate of the Rupee, III, 17.
- Nayak U. G. and P. C. Guha. Essential Oil from *Ocimum Killimanjaricum*, Guerke. III, 85.
- Nayak U. G. and P. C. Guha. Essential Oil form *Mentha Aravensis*. III, 86.
- Nayar, K. V. and Nayar. Formation of complex compounds between mercuric chloride and potassium chloride, III, 53.
- Nayar, M. R. and K. V. Nayar. Formation of complex compounds between mercuric chloride and potassium chloride, III, 53.
- Nayar, M. R. and K. V. Nayar. Formation of complex compounds between mercuric chloride and potassium chloride, III, 53.
- Nayar M. R. and R. C. Aggarwal. Studies on Transport Number. System: Barium-nitrate, alkali nitrate, water. III, 70.
- Nayar M. R. and V. B. S. Chauhan. Relation between adsorption and Base Exchange Capacity of Soils. III, 70.
- Narasimhan, M. J. Sclerotial disease of orobanche cernua Loefel, III, 36.
- Narasimhamurthi, V. and V. Kasisastri. Distribution of Income in India, III, 17.

- Narayanan, K. G. N. and N. K. Dutta. Liberation of histamine by Gobra (*Naja naja*) venom from isolated diaphragm of the rat III, 192.
- Narayanan, S. Thakral B. M. and Iyer S. G. The role of turning in relation to hatchability. III, 200.
- Narayanan, S., S. G. Iyer and B. M. Thakral. Inheritance of Smut (Slaty) under colour in Rhode Island Red. III, 201.
- Narayanan, S., S. Bose and B. M. Thakral. The processing of Cow manure for increased egg production. III, 201.
- Nath, M. C., and C. H. Chakrabarty, Studies on the effect of sodium acetoacetate on thiamine, III, 258.
- Nath, M. C. and J. S. Gadgil, Inhibition of $\frac{1}{2}$ -SH enzymes by intermediary fat metabolites. III, 256.
- Nath, M. C., and V. K. Sahu, Studies on the role of acetone bodies on carbohydrate metabolism. III, 255.
- Nath, M. C. and M. B. Dongree, The effect of intermediary fat metabolites on the process of transmethylation in liver, III, 256.
- Nath M. C. and R. P. Chitale. Effect of Vitamin B1 on the Bio-synthesis of Vit. C. in Lecuminous Seeds (Green Gram). III, 121.
- Nath M. C. and (Miss) K. S. Laul. The production of Acetone bodies by E. Coil. III, 120.
- Nath M. C. and (Miss) B. Belavadi. Studies on the Biosynthesis of vitamin C and a probable precursor. III, 120.
- Nayak K. V. and G. S. Deshmukh. On the Solubility of Rare Earth Hydroxides in Aqueous Sodium Potassium Tartrate. III, 152.
- Negi, S. S. and N. D. Kehar, Investigations on subsidiary Feeds: Mangrove (*Avicennia officinalis* Linn.) leaves as feed for cattle, III, 268.
- Neelakantan L. and P. C. Guha. Studies in Antimalarials, Part VIII. Bisamidino Sulphides. III, 89.
- Neelakantan L. and P. C. Guha. Studies in Antimalarials, Part VIII. Bisamidino Sulphides. III, 89.
- Neogy Rajat Kumar. Studies on the viscosity of emulsions. III, 80.
- Neelakantan L. and P. C. Guha. Studies in Antimalarials, Part VII. N-Substituted 2:6-diphenyl pyridones. III, 89.
- Nene M. W. and K. K. Dole. Reaction of Nitrates by Alumino-Thermic Reaction. III, 54.
- Nigam, S. D. Axisymmetric viscous flow past two spheres, III, 12.
- Niyogi, Dipankar. The Structure of the Alkaline Rocks of Kishangarh, Rajasthan. III, 188.
- Niyogi N. C. and G. C. Basak. A study of the Fischer, Tropesch Synthesis: Part I. Catalyst. III, 134.
- Niyogi N. C. and G. C. Basak. A study of the Fischer-Tropsch synthesis: Part II. Efficiency of the synthesis Process using Co-catalyst. III, 134.

O

- Officers of the Thirty-Ninth Congress I, 1.
- Office-Bearers of the Association 1951-52. I, 4.
- Oommen, Miss M., D. K. Ray, G. A. Shivani and R. Bhaskaran, A study on some Coccidia of Himalayan birds, III, 314.
- Oommen, Miss Mary, Entamoeba in cattle, III, 316.
- Opening Proceedings. I, 24.
- Ouadros, Albert S. De, Mixed cropping of Wheat and Gram as an insurance against Rust, III, 290.

- Osmani (Miss) Razia and D. S. Datar. Thermal Decomposition of Calcium Sulphate. III, 136.
- Osmani Miss Razia and D. S. Datar. Thermal Decomposition of Sodium Sulphate. III, 67.
- Osmani (Mrs.) Zubiada H. and K. Ramachandran. Itaconic acid production by *Aspergillus terreus*. III, 119.

P

- Padhi S. C. and Ramanamurti M. V. Influence of 'Ageing' on Joshi Effect in Nitrogen. III, 56.
- Padhi S. C. and Ramanamurti M. V. Production of Joshi-Effect in Nitrogen under Sleeve-Excitation: Influence of Gas Pressure and Volume. III, 56.
- Padhi, S. C. and M. V. Ramanamurti. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve excitation. III, 218.
- Pal, A., Gas Absorption in Bronzes during Melting. III, 240.
- Pal, A. K., S. Bose, T. D. Mahadevan and R. Narain. The determination of quality in eggs, based upon the physical and chemical characteristics of the eggs. III, 202.
- Pal, A. T., P. G. Ghosh and B. Chatterjee, On Testing, Standardisation and Blending of Foundry Sands. III, 234.
- Pal, B. M. and S. S. De, Studies on balanced Food, III, 261.
- Pande C. S. and Bose A. N. Formulation of Xomplex compounds between Urea and Ammonium Nitrate, III, 54.
- Pande, J. K. The Problem of Missing quotations, III, 14.
- Pandit, G. M. and D. P. Jatar. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge. III, 217.
- Pandit, G. M. and D. P. Jadar. Study of Joshi Effect in H₂ in a Siemens' Ozoniser Discharge: Influence of Splitting the L. T. Electrodes in (a) Earthed and (b) Floating Segments, III, 222.
- Pandit, G. M. and D. P. Jatar. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge. III, 217.
- Pandit, G. M. and D. P. Jatar, Studies of Negative Joshi Effect In Hydrogen Discharge with Metallic Electrodes: Influence of the Gas Pressure and Applied Potential, III, 221.
- Panigarahi, Gopinath. Effect of Colchicine on germination and growth of solanum Melongena, Lin. III, 25.
- Panja, D. and A. K. Banerjee. Nocardiosis of the skin and subcutaneous tissue in Bengal. III, 204.
- Panja, G. Our first and Foremost approach to the Prophylaxis of Leprosy in India. III, 195.
- Panja, D. and A. K. Banerjee. Treatment of Alopecia areata by intradermal injection of Milk and Methyl Acetyl Choline, III, 203.
- Pant, C. M. and K. P. Shukla, Exchangeable ions and Engineering Properties of Soils, III, 243.
- Panja, D. and A. K. Banerjee. Irtanitle allergy in relation to scabies, III, 203.
- Panja, G. Allergy in Skin Diseases, III, 194.
- Pant, G. M. and K. P. Shukla, Engineering Properties of Bundelkhand Soils, III, 245.
- Parikh, R. J. and Suresh Sethna. Bromination of 5-hydroxy-4, 7-dimethylcoumarin and its methyl ether, III, 95.
- Parikh, R. J. and V. M. Thakor. Fries and Friedel-Crafts Reactions in Coumarins, III, 94.
- Patani, M. J. and Trivedi, A. K. M. Hydration of Collodial Arsenic Sulphide, III, 55.

- Patani, M. J. and Trivedi, A. K. M. Constituents of Colloidal Arsenic Sulphide, III, 54.
- Fatel, J. M. and N. Prasad. Chitri Disease of Tobacco in Gujerat, III, 37.
- Pathak, P. D. Entropy of Liquid Helium II., III, 212.
- Patnaik, N., B. Ray Burman and L. Mahapatra. A Note on christian oraons in sundargarh district, Orissa, III, 45.
- Fatra, G., K. S. Viswanathan and A. K. Hota. Influence of temperature and pressure on irreversible Joshi-Effect in nitrogen in the hysteresis range below the threshold potential, III, 61.
- Patra, G., K. S. Viswanathan and A. K. Hota. Occurrence of Irreversible Joshi Effect in Hydrogen, III, 221.
- Pattnaik, H. and B. Samantarai. Response of *Dracaena angustifolia* twigs to synthetic hormones, III, 26.
- Patwardhan, V. A. and G. B. Nadkarni. Fatty Oil from the seeds of *Cassia fistula*, Linn, III, 115.
- Perraju, P. and C. Mahadevan. Geology of Yellamanchill Area, III, 183.
- Pershad, Guru Dayal and S. C. Chakravarti. Preliminary studies into the viability of immature Weed seeds, III, 25.
- Peruma, N. V. A. S. and C. Mahadevan. Manganiferous rocks and their associates in East Chipurupalle Area, Visakhapatnam District, III, 173.
- Phansalkar, G. R. and D. H. Vidwans. Recovery of Copper from low grade Sulphide Ores, III, 125.
- Phanasalkar, G. R. and Miss Subbalakshmi, P. V. Oxidation of Manganese with Red Lead, III, 159 and 160.
- Phansalkar, V. K. and S. K. K. Jatkar. Vibration, Rotation Spectra of Molecules, III, 212.
- Philip, C. J., P. G. N. Pillay and T. K. P. Kaimal. Studies in the tube well waters in the coastal areas of Travancore. Part I. Tube wells at Veli, III, 140.
- Philip, C. J., P. G. N. Pillay and T. K. P. Kaimal. Studies in the Tube Well Waters in the Coastal Areas of Travancore. Part I. "The Tube Wells at Veli", III, 142.
- Phukan, G. N. and N. C. Sen Gupta. Paper Chromatography of inorganic cations, III, 156.
- Physics: Some Aspects of Crystal Magnetism—Dr. S. Ramachandra Rao. II, 65.
- Physiology: Etiology of Diabetes—Dr. Sachchidananda Banerjee. II, 226.
- Pichamuthu, C. S. A preliminary note on clouded feldspars and metamorphism in Mysore, III, 174.
- Pillay, P. G. N., T. K. P. Kaimal and C. J. Philip, Studies in the Tube well Waters in the Coastal Areas of Travancore. Part I. "The Tube Wells at Velli", III, 142.
- Pillay, P. G. N., T. K. P. Maimal and C. J. Philip, Studies in the tube well water in the coastal areas of travancore, Part I. Tube wells at veli, III, 140.
- Pillay, P. P. and K. G. Das. Puffed Oil of *Calophyllum Inophyllum* (Linn.), III, 111.
- Fillay, P. P. and K. G. Das. Fatty acids present in the resin on the fixed of *calophyllum inophyllum* (Linn.), III, 113.
- Pillay, P. P. and K. G. Das. Isolation of Crystalline non-typical constituents from the fixed oil of *Calophyllum Inophyllum* (Linn.), III, 112.
- Fillay, P. P. and N. G. Das and N. Thanukrishnan. Chemical examination of the Roots of *Chonemorpha Macrophylla* (G. Don.), III, 113.
- Poddar, Sailendranath and Privada Ranjan Ray. Complex Compounds of Thiodicyandiamidine (Guanyl Thiourea) with Metallic Elements, III, 49.
- Programme of the Session. I, 20.
- Prabhu, S. S. and F. Bhattacharya. Studies on Sex behaviour of tritificial Insemination Bulls—1., III, 196.

- Prabhu, S. S., U. D. Sharma and P. Bhattacharya. Effect of short term feeding of vitamin A deficient rations on the reaction time and semen qualities of breeding Bulls, III, 197.
- Prabhu, S. S., K. D. Bhaya and P. Bhattacharya. Effect of lower protein level in ration on semen production and reaction time of Buffalo Bulls, III, 197.
- Prabhu, S. S. and P. Bhattacharya. Seasonal Variation in Conception Rates in Artificially bred cows, III, 197.
- Prabhu, S. S., P. Bhattacharya and S. N. Chatterjee. Secondary "Sex-ratio" of normal births in Indian Cattle—II., III, 196.
- Prasad, Kali and S. Zafar Hasan, Tension Among the students of the Lucknow University, III, 287.
- Prabhu, S. S., Bhattacharya and S. N. Chatterjee. Gestation periods of Indian Breeds of Cattle—II., III, 195.
- Prasad, B. N. and S. R. Sinha, Gibbs Phenomenon for Summability (G. K.), III, 6.
- Prasad, N. and I. M. Patel. Chitri Disease of Tobacco in Gujarat, III, 37.
- Prasad, M. R. N., Male reproductive tract of the Indian squirrels, III, 336.
- Prasad, Satrugan, A. S. Chachravarti, Durga Prasad Srivastava and K. L. Khanna, Studies in storage of gur—III., III, 304.
- Prasad, S. M. Provincial Industrial Research Laboratory, III, 145.
- Pratap, R. and S. K. Chakrabarty. On the Dynamo Theory of Geomagnetic Field Variations. III, 226.
- Prasad Surajdeo. Thermal Conductivity of Liquid Oxygen, III, 79.
- Puri, S. N. A Note on the occurrence of Gondwanidium and Bhriadia from the Karharbari Stage in the North Karanpura Coalfield, III, 183.
- Prasad, N. and C. C. Shah, Frog eye spot disease of tobacco, III, 309.
- Puri, V. Vascular Anatomy and Inferior Ovary, III, 29.
- Pal, B. M. and S. S. De, Mutual supplementation in vegetable proteins, III, 261.
- Pal, R. G., Dielectric Phenomenon in High-Voltage Transformers, III, 252.
- Pabus, U. P. and G. C. Esh, The relation between the yield and the nutritive value of wheat, III, 303.
- Parikh, N. M. and C. C. Saha, Symptoms of Manganese deficiency in common crops of Gujarat, III, 295.
- Patnayak, K. C., A new colour test for vitamin B₁.
- Parthasarathy, M. D., An account of the coxal glands in Scorplons, III, 324.
- Pathak, P. D. Liquid Helium II and Landau's Hydrodynamical Equations, III, 212.
- Pati, T., On the absolute summability of the conjugate series of Fourier series, III, 7.
- Fatil, S. S. and U. K. Kanitkar, Activation of growth of seedlings of wheat by treatment of seed with 2, 4-Dichlorophenoxy acetic Acid, III, 292.
- Patnayak, K. C., Thiamine and ascorbic acid contents of saliva and gastric juice of normal individuals, III, 258.
- Pd., Rajeshwar and S. L. Sharma. Studies of sampling Technique. Rind Hardness in Sugarcane, III, 290.
- Pramanik, B. N. and A. N. Misra. The effect of continuous manuring with Nitrogenous, phosphatic and potassic fertilizers on the population of Azotobacter Chroococum and on total bacteria in the soil, III, 296.
- Psychology and Educational Sciences: Human Relations on the Indian Scene—Pars Ram. II, 239.
- Punwani, D. M., Surface transport of the fingerlings of the Mirror Carp, the Leather Carp, and the Scale carp from the Nilgiris to West Bengal, III, 326.

R

- Radhakrishna, B. P. Geology of the Dodguni Anticline, III, 181.

- Radhakrishnan, B. F. Cordierite—Hypersthene Granulites near Kunigal Bordering the Western margin of Closepet Granite, III, 178.
- Rafey, S. A., Wilt Disease of Cane, III, 307.
- Raghavan, M., K. Raman and P. C. Guha. Studies in Antimalarials, Part VI. Some N1—and N5—substituted Biguanides, III, 89.
- Raghavan, M., K. V. Viswanathan and P. C. Guha. Studies on Antimalarials, Part V. Some N1—and N3—substituted Derivatives of Metanilamide, III, 88.
- Rahman, A., History of Science and some problems in teaching, III, 284.
- Rai Chaudhuri, H. N. and D. Datta, Pharmacognostic studies on *Euphorbia pilulifera* Linn, III, 41.
- Rai Chaudhuri, H. N. and Amiya Datta, Comparative anatomical studies on the leaves of *Hyoscyamus niger* L. and *H. muticus* L., III, 42.
- Rai Chaudhuri, H. N. and S. C. Datta. Effect of different physiological factors on the growth and alkaloid content of *datura metel* Linn., III, 41.
- Rajadhyaksha, A. S. and K. K. Dole, Dehydration of Castor Oil with "Mixed Alkane Sulphonic Acid" as a Catalyst, III, 139.
- Rajan, V. D., S. S. Banerjee and R. R. Mehrotra, Long distance scattering of radio waves and undulations in the ionosphere, III, 251.
- Rajopadhye, V. Y. The Flame Spectra Some Phosphorus and Sulphur Compounds, III, 212.
- Rakshit S. C. Electrokinetic Potentials of Solid Stabilised Emulsion, III, 79.
- Ram, Atma, J. C. Banerjee, S. B. Roy and Y. P. Varshney. Studies on Indian Tales—Part I. General Chemical and Mineralogical Characteristics, III, 126.
- Ram J. Sri and K. V. Giri. Starch Synthesising Enzymes of Green Gram, III, 116.
- Ram Atma, J. C. Banerjee, S. B. Roy and Y. P. Varshney. Studies on Indian Tales—Part III. Properties on Firing, III, 126.
- Ram Atma, S. C. Majumdar, K. D. Sharma and Y. P. Varshney. Utilisation of salt cake in the Indian Glass Industry, III, 127.
- Ram Atma, S. P. Krishnaswami, P. Roy and Y. P. Varshney. On Glass Bottles suitable for containing inks, III, 127.
- Ram, K. B. and R. S. Roy, Control of maggot hopper in Bihar, III, 305.
- Ram, Gurudas, S. Banerjee, and S. K. Guha. A Preliminary Vibration on the Khadakwasla dam (Poona, India), III, 252.
- Ramadas, K., R. Satyanarayana and S. R. Khastgir, Study of the Polarization of the Downcoming Wireless Waves of Medium Wavelengths, III, 227.
- Raman, K., M. Raghavan and P. C. Guha. Studies in Antimalarials, Part VI. Some N1—and N5—substituted Biguanides, III, 89.
- Ramachandran, K. and N. Shanmukha Rao. Production of Levulinic acid from molasses, III, 103.
- Ramachandran, K. and Osmani (Mrs.) Zubiada H. Itaconic acid production by *Aspergillus terreus*, III, 119.
- Ramchandran, M., S. C. Balasubramanian, T. Viswanathan and S. S. De, Amino acid composition of Indian food-stuffs, III, 261.
- Ramachandran, P. K. and R. H. Sahasrabudhey. Separation of Methylamines. Part I, III, 82.
- Ramaiah, N. A. and P. V. Ratnam. Influence of a Strong Magnetic Field (H) on the Behaviour of Siemens' Ozonizer Giving Joshi Effect under Electric Discharge, III, 223.
- Ramaiah, N. A. and P. V. Ratnam. Influence of Wall-coatings on Joshi effect in Water Vapour, III, 61.
- Ramaiah, N. A. and K. Parvati Devi. Surface Sensitivity of Joshi Effect in Water Vapour, III, 216.

- Ramkrishnan, T. A. and E. John Jacob, Travancore Marine Oils: Green Turtle Oil. Part I. Effect of certain phenolic substances on the stability of turtle oil, III, 141.
- Ramaiah, N. A. Dependence of Effect on the Electronic Part of the Discharge Current, III, 220.
- Ramakrishna, T. A. and E. John Jacob, Part II. Effect of gallic acid derivatives on the development of rancidity of Turtle Oil, III, 141.
- Ramakrishnan, T. A. and E. John Jacob, Travancore Marine Oils-Green Turtle Oil. Deodorisation of Turtle Oil. Part I. Selective Hydrogenation, III, 142.
- Ramakrishna, V. and S. K. Bhattacharyya. Magnetism and Catalysis. Part I., Magnetic study of Vanadium Catalysts, III, 66.
- Ramaliah N. A. and K. Parvati Devi. Comparative Studies of Joshi effect in H₂O and H₂S. III, 61.
- Ramamurthi, C. S. and M. J. Thirumalachar. Dry rot of tubers and sprout injury in potato incited by *Aspergillus* sp., III, 38.
- Ramanamurti, M. V. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material. III, 219.
- G**
- Ramanamurti, M. V. and G. R. Somayajulu. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part II: Role of Partial Irradiation, III, 219.
- Ramanamurti, M. V. Influence of Frequency of Exciting Potential on Joshi Effect in Nitrogen, III, 220.
- Ramanamurti, M. V. and G. R. Somayajulu, Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material, III, 219.
- Ramanamurti, M. V. Studies of Joshi Effect in Stationary and Flowing Gas Systems under Silent Discharge. III, 218.
- Ramachandran, P. K. and R. H. Sahasrabudhey. Separation of Methylamines. Part II. III, 83.
- Ramanamurti, M. V. and G. R. Somayajulu. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part II: Role of Partial Irradiation. III, 219.
- Ramanamurti, M. V. Studies of Joshi Effect in Stationary and Flowing Gas Systems under Silent Discharge. III, 218.
- Ramanamurti, M. V. and S. C. Padhi. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve Excitation. III, 218.
- Ramanamurti, M. V. and S. C. Padhi. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve Excitation. III, 218.
- Ramanamurti, M. V. and G. R. Somayajulu. Role of Electrode Asymmetry and Partial Irradiation in the Production of Joshi effect in Nitrogen. III, 55.
- Ramanamurti, M. V. and S. C. Padhi. Production of Joshi-Effect in Nitrogen under Sleeve-Excitation: Influence of Gas Pressure and Volume. III, 56.
- Ramanamurti M. V. S. C. Padhi. Influence of 'Ageing' on Joshi Effect in Nitrogen. III, 56.
- Ramanamurti M. V. and G. R. Somayajulu. Preferential Incidence of Joshi effect in the Ohmic Part of Ozonizer Current in Nitrogen under Silent Discharge. III, 55.
- Ramanamurti, M. V. and G. R. Somayajulu. Studies of Joshi Effect in Nitrogen Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material. III, 219.
- Ramaswami, L. S., The squill of *Gastromyzonid* fishes, III, 331.

- Ramnani, D. R. and S. B. V. Rao. Infectious coryza of Fowls in India. III, 201.
- Rangayya, R. and C. Mahadevan. Geology of N. W. parts of Nellore District
With special reference to origin of copper and barite. III, 171.
- Rand, D. R. and P. J. Deoras. Studies on Poona Flies 1. III, 195.
- Rao Balabheem and S. H. Zaheer. Investigations on Engobes. III, 138.
- Rao, B. Kukkuteswara and C. Mahadevan. Some observations on the interaction
of Eastern Ghat rockhsuites in Visakhapatnam District. III, 173.
- Rao, B. S. Narayan and M. S. Iyengar, Alcohol Petrol Blends as Fuels in I. G.
Engine, III, 232.
- Rao, B. S. Narayan, M. S. Iyengar and R. Vaidyeswaran, Influence of Controlled
Oxidation of Non-Caking Indian Coal on the Products of Low Temperature
Carbonisation, III, 237.
- Rao, Bendapuri Subba. Mahi Valley Microlithic Industry, III, 45.
- Rao, B. V. Venkata and S. V. Govindarajan, Associated growth of Legumes and
Cereals, III, 290.
- Rao, B. V. Venkata and S. V. Govindarajan, Phosphate manuring of legumes its
influence on Nitrogen Fixation and on the yield of succeeding crop of
cereal III, 300.
- Rao, C. Borreswara and C. Mahadevan. Genesis of Steatitie in Mutchukota Area.
III, 171.
- Rao, C. Rama, S. Kuppuswamy, Saranya Kumari Reddy and M. Swaminath, Bio-
logical value of Proteins of synthetic grains from Tapioca and Groundnut
Flour, III, 274.
- Rao, Krishna J. S. R. and C. Mahadevan. Manganese gurnets from Shipurupalle Area,
Vizagapatam District. III, 170.
- Rao, C. V. N., T. N. Mehta and P. Sen. Behaviour of certain edible oils in the Frying
Pan. III, 148.
- Rao, H. G. Gopal and S. V. Govindarajan, Influence of minor elements on Mysore Salts
and Crops. Response of Ragi of Zinc Salts. III, 294.
- Rao, Krishna G. S., Sukh Dev and P. C. Guha. A study of the Essential Oil from
the Oleo-resin of *Dipterocarpus Indicus*. III, 91.
- Rao, Krishna G. S., Sukh Dev and P. C. Guha. A study of the Essential Oil from
wood of *Cedrus Deodara*. III, 91.
- Rao, K. S. Extension of the Romonovsky Bartlett-Scheffe'-Beranwin Test. III, 16.
- Rao, K. S., Tests for independent Normality in Economic Time Series. III, 16.
- Rao, K. V. Narayan and A. K. Bhattacharya. Studies in Acetone Iodine Reaction.
III, 76.
- Rao, M. R., Morphogenesis of the thymus gland in Anuran metamorphosis, III, 335.
- Rao, M. V. Lakshmin arayan and M. R. Sahasrabudhe, Optimal Dietary Fat Level
in relation to growth Tissue-Composition. III, 272.
- Rao, M. V. Lakshminarayan and M. R. Sahasrabudhe, Effect of Vitamin B12 on the
Syntheses of Protein and Nucleic Acids in the Protein. III, 271.
- Rao, M. V. Lakshminarayan and M. R. Sahasrabudhe, Nutritive value of Vegetable
Proteins in relation to Liver protein Maintenance. III, 271.
- Rao, M. V. Lakshminarayan and M. R. Sahasrabudhe, Comparative study of various
fat Suppliments to the low protein diets in relation to growth and liver Fat
Deposition. III, 271.
- Rao, N. Shanmukha and K. Ramachandran. Production of Levulinic acid from
molasses. III, 103.
- Rao, S. B. V. and D. R. Ramnani. Infectious coryza of Fowls in India. III, 201.
- Rao, S. K. R., and N. S. N. Sastry, Towards measuring social distances. III, 287.

- Rao, P. Satyanarayan and C. Mahadevan. The Geology of the Manganese-bearing Rocks of Rayagada, Koraput District, Orissa. III, 174.
- Rao, Subba K. and S. K. Wadhawan. Studies in Soil Permeability II. The effect of ageing of the dehydrated soil on its Permeability. III, 146.
- Rao, Subba K. and S. K. Wadhawan. Studies in Soil Permeability I. The effect of temperature of dehydration of the soil on its permeability. III, 146.
- Rao, Dr. S. R. Schistosomiasis Dogs in Bombay State. III, 199.
- Rao, Dr. S. R. Eimeria Smithi as a cause of coccidiosis in cattle of the Bombay State. III, 199.
- Rao, S. V. Lakshmi Narayan. Economic Minerals of Kothavalsa area Visakhapatnam District. III, 184.
- Rao, S. Venkob, K. T. Achaya and S. A. Saletore. Chlorination of Ricinoleic acid and its Methyl ester. III, 104.
- Rao, V. L. S. P. and K. N. Mukherjee. Agricultural Land productivity of West Bengal. III, 187.
- Rastogi, M. C. and A. C. Chatterji. Adsorption of the Sols and their Constituent Ions by Freshly Precipitated Sparingly Soluble Salts Part I. III, 67.
- Rastogi, M. C. Liesegang Ring formation of the sparingly Soluble Salts of Rare Elements in Agar-Agar and Starch Gel. Part II. III, 70.
- Rastogi, M. C. Distribution of the Sparingly Soluble Salts in Periodic Structures. Part II. III, 70.
- Rastogi, R. P. and A. C. Chatterjee. Activity of Water and its Temperature Dependence in Supersaturated Solutions of electrolytes. III, 69.
- Rastogi, R. P. and A. C. Chatterjee. Role of Foreign Substances in the Release supersaturation. III, 67.
- Rastogi, R. P. and A. C. Chatterjee. Temperature Dependence of Vapour pressure in Supersaturated Solutions. III, 68.
- Ratnam, P. V. and N. A. Ramaiah. Influence of a Strong Magnetic Field (H) on the Behaviour of Siemens' Ozonizer Giving Joshi Effect under Electric Discharge, III, 223.
- Ratnam, P. V. and N. A. Ramaiah. Influence of Wall-coatings on Joshi effect in Water Vapour. III, 61.
- Rau, M. Anantaswamy. The Endosperm in the Leguminoae. III, 23.
- Rawat, J. S., G. S. Lal and A. Roy. Hormal values of some Chemical Constituents of Buffalo Blood, III, 263.
- Ray, C. A preliminary study of crystal-size variation in a dolerite dyke, Jamunia River, Jharia Coalfield. III, 168.
- Ray, C. Anorthosite in Chilka Area. III, 177.
- Rya, D. K., G. A. Shivani, Miss. M. Ommen and R. Bhaskaran, A study on some Coccidia of Himalayan birds. III, 314.
- Ray, D. K., On a new coccidium Eimeria hawkinsi n.s., from Indian sheep and goats. III, 314.
- Ray, D. K., Observations on the comparative efficiency of Zinc sulphate, Sugar and Salt solutions for the floatation of Coccidial oocysts of sheep & goat. III, 315.
- Ray, D. K., On a new coccidium Eimeria sphenocercae n.sp., from Sphenoceros sphenurus (Kokla green pigeon), III, 313.
- Ray, H. N. and G. A. Shivani, Treatment of equine surra in India with Antrycide Methyl Sulphate. III, 202.
- Ray, H. N., Philip A. Hawkins and G. A. Shivani. Preliminary observations on splenectomy and piroplasmosis in cattle. III, 198.
- Ray, Kumud Bhushan, Hirakund Dam Project. III, 242.

- Ray, S. and A. B. Biswas. A Biotite lamprophyre (Mica-peridotite) from the copper belt of Dhalbhum. III, 177.
- Ray, S. C., Feeding Soyabean emulsion as a partial substitute for whole milk in raising dairy calves. III, 263.
- Ray, S. N., K. Sahai and N. D. Kehar, Investigation on the optimum level of fat in the ration of ruminants. III, 267.
- Ray, Priyada Ranjan and Debabrata Bandyapadhyaya. Stability chromium (II) Biguanide and chromium (III) phenylbiguanide complexes. III, 50.
- Ray, Priyada Ranjan and Ajit Kumar Mukherjee. Inner-Metallic Complex Salts of Sulphanilamide-Salicylaldehyde and its Derivative, III, 49.
- Ray, Priyada Ranjan and Amiya Kumar Chakraborty. Complex compounds of certain Bivalent metals with Diglycyl-ethylenediamine and Determination of their Instability Constants. III, 50.
- Ray, Priyada Ranjan and Basudev Das Sarma. (On the Stability of Inner-Metallic Complexes. III, 48.
- Ray, Priyada Ranjan and Sailendranath Podder. Complex compounds of Thiodicyandiamidine (Fuanyl Thiourea) with Metallic Elements, III, 49.
- Ray Priyadarajan and Nakuleswar Kundu. Transformation of Biguanide into Dicycndiamidines. III, 100.
- Ray Burman, B., N. Patnaik and L. Mahapatra. A Note of christian orans in sundargarh district, Orissa, III, 45.
- Raychaudhuri, S. and S. Sen. Shape analysis of Gondwana Sandstones of the Raniganj Basin. III, 188.
- Raychaudhuri, Sunilkumar and Saurindranath Sen. Structure and Petrology of a Dolerite Dyke Near Shibulihari ($86^{\circ} 44' 40''\text{E}$, $23^{\circ} 39'\text{N}$), N. Manbhum, Bihar. III. 189.
- Ray-Chaudhuri, S. P., N. N. Das Gupta and A. Guha, A new method for the study of chromosomes of grasshoppers by the electron microscope, III, 310.
- Ray-Chaudhury, S. F. and B. N. Bole Gowda, A study on the chromosomes during spermatogenesis in two spiders *Hersilia savygni* and *Steogodyphus sarasinorum*, III, 311.
- Ray-Chaudhuri, S. F. and B. N. Bole Gowda, Further evidences on the occurrence of XO mechanism of sex determination in spiders, III, 311.
- Ray Choudhuri A., T. N. Ghosh and A. K. Kundu. Search for New Antispasmodics. Part IV. III. 96.
- Ray Choudhuri Amitabha and Achintya Kamal Sen. Synthesis of 8-Aminoquinolines. III, 96.
- Ray Chowdhury, K., Colour Vision and Colour preference, III, 278.
- Ray Chowdhury, K. M., Psychic Bisexuality of Rabindra Nath Tagore, III, 277.
- Ray-Chaudhuri, S. P., and Ira Sarkar, Frequency of anaphase bridges in the grasshopper. *Gesonía punctifrons* at different intervals after X-radiation, hopper. *Gesonía punctifrons* at different intervals after X-radiation, III, 310.
- Razdan R. K., S. C. Bhattacharyya and P. C. Guha. Study of the sesquiterpene Portion of Piper Cubeba, Linu. III, 85.
- Razi, B. A. and S. P. Agharkar, Some aspects of the embryology of *Lawia zeylanica* and *Zeylanidian olivaceum*, III, 22.
- Reddy, D. Bap, Complex factors and the behaviour of adult Rice Weevils, III, 319.
- Regulations. I, 62.
- Reddy, Saranya Kumari, S. S. Kuppuswamy, G. Rama Rao and M. Swaminath, Biological value of Proteins of synthetic grains from Tapioca and Ground-nut Flour, III, 274.

- Osmani (Miss) Razia and D. S. Datar. Thermal Decomposition of Calcium Sulphate. III, 136.
- Osmani Miss Razia and D. S. Datar. Thermal Decomposition of Sodium Sulphate. III, 67.
- Osmani (Mrs.) Zubiada H. and K. Ramachandran. Itaconic acid production by *Aspergillus terreus*. III, 119.

P

- Padhi S. C. and Ramanamurti M. V. Influence of 'Ageing' on Joshi Effect in Nitrogen. III, 56.
- Padhi S. C. and Ramanamurti M. V. Production of Joshi-Effect in Nitrogen under Sleeve-Excitation: Influence of Gas Pressure and Volume. III, 56.
- Padhi, S. C. and M. V. Ramanamurti. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve excitation. III, 218.
- Pal, A., Gas Absorption in Bronzes during Melting. III, 240.
- Pal, A. K., S. Bose, T. D. Mahadevan and R. Narain. The determination of quality in eggs, based upon the physical and chemical characteristics of the eggs. III, 202.
- Pal, A. T., P. G. Ghosh and B. Chatterjee, On Testing, Standardisation and Blending of Foundry Sands. III, 234.
- Pal, B. M. and S. S. De, Studies on balanced Food, III, 261.
- Pande C. S. and Bose A. N. Formulation of Xomplex compounds between Urea and Ammonium Nitrate, III, 54.
- Pande, J. K. The Problem of Missing quotations, III, 14.
- Pandit, G. M. and D. P. Jatar. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge. III, 217.
- Pandit, G. M. and D. P. Jadar. Study of Joshi Effect in H₂ in a Siemens' Ozoniser Discharge: Influence of Splitting the L. T. Electrodes in (a) Earthed and (b) Floating Segments, III, 222.
- Pandit, G. M. and D. P. Jatar. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge. III, 217.
- Pandit, G. M. and D. P. Jatar, Studies of Negative Joshi Effect In Hydrogen Discharge with Metallic Electrodes: Influence of the Gas Pressure and Applied Potential, III, 221.
- Panigarahi, Gopinath. Effect of Colchicine on germination and growth of solanum Melongena, Lin. III, 25.
- Panja, D. and A. K. Banerjee. Nocardiosis of the skin and subcutaneous tissue in Bengal. III, 204.
- Panja, G. Our first and Foremost approach to the Prophylaxis of Leprosy in India. III, 195.
- Panja, D. and A. K. Banerjee. Treatment of Alopecia areata by intradermal injection of Milk and Methyl Acetyl Choline, III, 203.
- Fant, C. M. and K. P. Shukla, Exchangeable ions and Engineering Properties of Soils, III, 243.
- Panja, D. and A. K. Banerjee. Irtanitle allergy in relation to scabies, III, 203.
- Panja, G. Allergy in Skin Diseases, III, 194.
- Pant, G. M. and K. P. Shukla, Engineering Properties of Bundelkhand Soils, III, 245.
- Parikh, R. J. and Suresh Sethna. Bromination of 5-hydroxy-4, 7-dimethylcoumarin and its methyl ether, III, 95.
- Parikh, R. J. and V. M. Thakor. Fries and Friedel-Crafts Reactions in Coumarins, III, 94.
- Patani, M. J. and Trivedi, A. K. M. Hydration of Collodial Arsenic Sulphide, III, 55.

- Patani, M. J. and Trivedi, A. K. M. Constituents of Colloidal Arsenic Sulphide, III, 54.
- Patel, J. M. and N. Prasad. Chitri Disease of Tobacco in Gujerat, III, 37.
- Pathak, P. D. Entropy of Liquid Helium II., III, 212.
- Patnaik, N., B. Ray Burman and L. Mahapatra. A Note on christian oraons in sundargarh district, Orissa, III, 45.
- Patra, G., K. S. Viswanathan and A. K. Hota. Influence of temperature and pressure on irreversible Joshi-Effect in nitrogen in the hysteresis range below the threshold potential, III, 61.
- Patra, G., K. S. Viswanathan and A. K. Hota. Occurrence of Irreversible Joshi Effect in Hydrogen, III, 221.
- Pattnaik, H. and B. Samantarai. Response of *Dracaena angustifolia* twigs to synthetic hormones, III, 26.
- Patwardhan, V. A. and G. B. Nadkarni. Fatty Oil from the seeds of *Cassia fistula*, Linn, III, 115.
- Perraju, P. and C. Mahadevan. Geology of Yellamanchill Area, III, 183.
- Pershad, Guru Dayal and S. C. Chakravarti. Preliminary studies into the viability of immature Weed seeds, III, 25.
- Peruma, N. V. A. S. and C. Mahadevan. Manganiferous rocks and their associates in East Chipurupalle Area, Visakhapatnam District, III, 173.
- Phansalkar, G. R. and D. H. Vidwans. Recovery of Copper from low grade Sulphide Ores, III, 125.
- Phanasalkar, G. R. and Miss Subbalakshmi, P. V. Oxidation of Manganese with Red Lead, III, 159 and 160.
- Phansalkar, V. K. and S. K. K. Jatkari. Vibration, Rotation Spectra of Molecules, III, 212.
- Philip, C. J., P. G. N. Pillay and T. K. P. Kaimal. Studies in the tube well waters in the coastal areas of Travancore. Part I. Tube wells at Veli, III, 140.
- Philip, C. J., P. G. N. Pillay and T. K. P. Kaimal. Studies in the Tube Well Waters in the Coastal Areas of Travancore. Part I. "The Tube Wells at Veli", III, 142.
- Phukan, G. N. and N. C. Sen Gupta. Paper Chromatography of inorganic cations, III, 156.
- Physics: Some Aspects of Crystal Magnetism—Dr. S. Ramachandra Rao. II, 65.
- Physiology: Etiology of Diabetes—Dr. Sachchidananda Banerjee. II, 226.
- Pichamuthu, C. S. A preliminary note on clouded feidspars and metamorphism in Mysore, III, 174.
- Pillay, P. G. N., T. K. P. Kaimal and C. J. Philip, Studies in the Tube well Waters in the Coastal Areas of Travancore. Part I. "The Tube Wells at Velli", III, 142.
- Pillay, P. G. N., T. K. P. Maimal and C. J. Philip, Studies in the tube well water in in the coastal areas of travancore, Part I. Tube wells at veli, III, 140.
- Pillay, P. P. and K. G. Das. Puffed Oil of *Calophyllum Inophyllum* (Linn.), III, 111.
- Pillay, P. P. and K. G. Das. Fatty acids present in the resin on the fixed of *calophyllum inophyllum* (Linn.), III, 113.
- Pillay, P. P. and K. G. Das. Isolation of Crystalline non-typical constituents from the fixed oil of *Calophyllum Inophyllum* (Linn.), III, 112.
- Pillay, P. P. and N. G. Das and N. Thanukrishnan. Chemical examination of the Roots of *Chonemorpha Macrophylla* (G. Don.), III, 113.
- Poddar, Sailendranath and Priyada Ranjan Ray. Complex Compounds of Thiodicy andiamidine (Guanyl Thiourea) with Metallic Elements, III, 49.
- Programme of the Session. I, 20.
- Prabhu, S. S. and F. Bhattacharya. Studies on Sex behaviour of artificial Insemination Bulls—1., III, 196.

- Prabhu, S. S., U. D. Sharma and P. Bhattacharya. Effect of short term feeding of vitamin A deficient rations on the reaction time and semen qualities of breeding Bulls, III, 197.
- Prabhu, S. S., K. D. Bhaya and P. Bhattacharya. Effect of lower protein level in ration on semen production and reaction time of Buffalo Bulls, III, 197.
- Prabhu, S. S. and P. Bhattacharya. Seasonal Variation in Conception Rates in Artificially bred cows, III, 197.
- Prabhu, S. S., P. Bhattacharya and S. N. Chatterjee. Secondary 'Sex-ratio' of normal births in Indian Cattle—II., III, 196.
- Prasad, Kali and S. Zafar Hasan, Tension Among the students of the Lucknow University, III, 287.
- Prabhu, S. S., Bhattacharya and S. N. Chatterjee. Gestation periods of Indian Breeds of Cattle—II., III, 195.
- Prasad, B. N. and S. R. Sinha, Gibbs Phenomenon for Summability (G. K.), III, 6.
- Prasad, N. and I. M. Patel. Chitri Disease of Tobacco in Gujerat, III, 37.
- Prasad, M. R. N., Male reproductive tract of the Indian squirrels, III, 336.
- Prasad, Satrugan, A. S. Chachravarti, Durga Prasad Srivastava and K. L. Khanna, Studies in storage of gur—III., III, 304.
- Prasad, S. M. Provincial Industrial Research Laboratory, III, 145.
- Pratap, R. and S. K. Chakrabarty. On the Dynamo Theory of Geomagnetic Field Variations, III, 226.
- Prosad Surajdeo. Thermal Condchctivity of Liquid Oxygen, III, 79.
- Puri, S. N. A Note on the occurrence of Gondwanidium and Bhriadia from the Karharbari Stage in the North Karanpura Coalfield, III, 183.
- Prasad, N. and C. C. Shah, Frog eye spot disease of tobauco, III, 309.
- Puri, V. Vascular Anatomy and Inferior Ovary, III, 29.
- Pal, B. M. and S. S. De, Mutual supplementation in vegetable proteins, III, 261.
- Pal, R. G., Dielectric Phenomenon in High-Vollage Transformers, III, 252.
- Pabus, U. P. and G. C. Esh, The relation between the yield and the nutritive value of wheat, III, 303.
- Parikh, N. M. and C. C. Saha, Symptoms of Manganese deficiency in common crops of Gujrat, III, 295.
- Patnayak, K. C., A new colour test for vitamin B₁.
- Parthasarthy, M. D., An account of the coxal glands in Scorplons, III, 324.
- Pathak, P. D. Liquid Heliun II and Landau's Hydrodynamical Equations, III, 212.
- Patl, T., On the absolute summability of the conjute series of Fourier series, III, 7.
- Fatil, S. S. and U. K. Kanitkar, Activation of growth of seedings of wheat by treatment of seed with 2, 4-Dichlorophenoxy acetic Acid, III, 292.
- Patnayak, K. C., Thiamine and ascorbic acid contents of saliva and gastric juice of normal individuals, III, 258.
- Pd., Rajeshwar and S. L. Sharma, Studies of sampling Technique. Rind Hardness in Sugarcane, III, 290.
- Pramanik, B. N. and A. N. Misra, The effect of continuous manuring with Nitrogenous, phosphatic and potassic fertilizers on the population of Azotobacter Chroococum and on total bacteria in the soil, III, 296.
- Psychology and Educational Sciences: Human Relations on the Indian Scene—Pars Ram. II, 239.
- Punwani, D. M., Surface transport of the fingerlings of the Mirror Carp, the Leather Carp, and the Scale carp from the Nilgiris to West Bengal, III, 326.

II

- Radhakrishna, B. P. Geology of the Dodguni Anticline, III, 181.

- Radhakrishnan, B. F. Cordierite--Hypersthene Granulites near Kunigal Bordering the Western margin of Closepet Granite, III, 178.
- Rafey, S. A., Wilt Disease of Cane, III, 307.
- Raghavan, M., K. Raman and P. C. Guha. Studies in Antimalarials, Part VI. Some N1--and N5--substituted Biguanides, III, 89.
- Raghavan, M., K. V. Viswanathan and P. C. Guha. Studies on Antimalarials, Part V. Some N1--and N3--substituted Derivatives of Metanilamide, III, 88.
- Rahman, A., History of Science and some problems in teaching, III, 284.
- Rai Chaudhuri, H. N. and D. Datta, Pharmacognostic studies on *Euphorbia pilulifera* Linn, III, 41.
- Rai Chaudhuri, H. N. and Amiya Datta, Comparative anatomical studies on the leaves of *Hyoscyamus niger* L. and *H. muticus* L., III, 42.
- Rai Chaudhuri, H. N. and S. C. Datta. Effect of different physiological factors on the growth and alkaloid content of *datura metel* Linn., III, 41.
- Rajadhyaksha, A. S. and K. K. Dole, Dehydration of Castor Oil with "Mixed Alkane Sulphonic Acid" as a Catalyst, III, 139.
- Rajan, V. D., S. S. Banerjee and R. R. Mehrotra, Long distance scattering of radio waves and undulations in the ionosphere, III, 251.
- Rajopadhye, V. Y. The Flame Spectra Some Phosphorus and Sulphur Compounds. III, 212.
- Rakshit S. C. Electrokinetic Potentials of Solid Stabilised Emulsion, III, 79.
- Ram, Atma, J. C. Banerjee, S. B. Roy and Y. P. Varshney. Studies on Indian Tales--Part I. General Chemical and Mineralogical Characteristics, III, 126.
- Ram J. Sri and K. V. Giri. Starch Synthesising Enzymes of Green Gram, III, 116.
- Ram Atma, J. C. Banerjee, S. B. Roy and Y. P. Varshney. Studies on Indian Tales--Part III. Properties on Firing, III, 126.
- Ram Atma, S. C. Majumdar, K. D. Sharma and Y. P. Varshney. Utilisation of salt cake in the Indian Glass Industry, III, 127.
- Ram Atma, S. P. Krishnaswami, P. Roy and Y. P. Varshney. On Glass Bottles suitable for containing inks, III, 127.
- Ram, K. B. and R. S. Roy, Control of mago hopper in Bihar, III, 305.
- Ram, Gurudas, S. Banerjee, and S. K. Guha. A Preliminary Vibration on the Khadakwasla dam (Poona, India), III, 252.
- Ramadas, K., R. Satyanarayana and S. R. Khastgir, Study of the Polarization of the Downcoming Wireless Waves of Medium Wavelengths, III, 227.
- Raman, K., M. Raghavan and P. C. Guha. Studies in Antimalarials, Part VI. Some N1--and N5--substituted Biguanides, III, 89.
- Ramachandran, K. and N. Shanmukha Rao. Production of Levulinic acid from molasses, III, 103.
- Ramachandran, K. and Osmani (Mrs.) Zubiada H. Itaconic acid production by *Aspergillus terreus*, III, 119.
- Ramchandran, M., S. C. Balasunramanian, T. Viswanathan and S. S. De. Amino-acid composition of Indian food-stuffs, III, 261.
- Ramachandran, P. K. and R. H. Sahasrabudhey. Separation of Methylamines. Part I., III, 82.
- Ramaiah, N. A. and P. V. Ratnam. Influence of a Strong Magnetic Field (H) on the Behaviour of Siemens' Ozonizer Giving Joshi Effect under Electric Discharge, III, 223.
- Ramaiah, N. A. and P. V. Ratnam. Influence of Wall-coatings on Joshi effect in Water Vapour, III, 61.
- Ramaiah, N. A. and K. Parvati Devi. Surface Sensitivity of Joshi Effect in Water Vapour, III, 216.

- Ramakrishnan, T. A. and E. John Jacob, Travancore Marine Oils: Green Turtle Oil. Part I. Effect of certain phenolic substances on the stability of turtle oil, III, 141.
- Ramaiah, N. A. Dependence of Effect on the Electronic Part of the Discharge Current, III, 220.
- Ramakrishna, T. A. and E. John Jacob, Part II. Effect of gallic acid derivatives on the development of rancidity of Turtle Oil, III, 141.
- Ramakrishnan, T. A. and E. John Jacob, Travancore Marine Oils-Green Turtle Oil. Deodorisation of Turtle Oil. Part I. Selective Hydrogenation, III, 142.
- Ramakrishna, V. and S. K. Bhattacharyya. Magnetism and Catalysis. Part I., Magnetic study of Vanadium Catalysts, III, 66.
- Ramaliah N. A. and K. Parvati Devi. Comparative Studies of Joshi effect in H₂O and H₂S. III, 61.
- Ramamurthi, C. S. and M. J. Thirumalachar. Dry rot of tubers and sprout injury in potato incited by *Aspergillus* sp., III, 38.
- Ramanamurti, M. V. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material. III, 219.
- Ramanamurti, M. V. and G. R. Somayajulu. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part II: Role of Partial Irradiation, III, 219.
- Ramanamurti, M. V. Influence of Frequency of Exciting Potential on Joshi Effect in Nitrogen, III, 220.
- Ramanamurti, M. V. and G. R. Somayajulu, Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material, III, 219.
- Ramanamurti, M. V. Studies of Joshi Effect in Stationary and Flowing Gas Systems under Silent Discharge. III, 218.
- Ramachandran, P. K. and R. H. Sahasrabudhey. Separation of Methylamines. Part II. III, 83.
- Ramanamurti, M. V. and G. R. Somayajulu. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part II: Role of Partial Irradiation. III, 219.
- Ramanamurti, M. V. Studies of Joshi Effect in Stationary and Flowing Gas Systems under Silent Discharge. III, 218.
- Ramanamurti, M. V. and S. C. Padhi. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve Excitation. III, 218.
- Ramanamurti, M. V. and S. C. Padhi. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve Excitation. III, 218.
- Ramanamurti, M. V. and G. R. Somayajulu. Role of Electrode Asymmetry and Partial Irradiation in the Production of Joshi effect in Nitrogen. III, 55.
- Ramanamurti, M. V. and S. C. Padhi. Production of Joshi-Effect in Nitrogen under Sleeve-Excitation: Influence of Gas Pressure and Volume. III, 56.
- Ramanamurti M. V. S. C. Padhi. Influence of 'Ageing' on Joshi Effect in Nitrogen. III, 56.
- Ramanamurti M. V. and G. R. Somayajulu. Preferential Incidence of Joshi effect in the Ohmic Part of Ozonizer Current in Nitrogen under Silent Discharge. III, 55.
- Ramanamurti, M. V. and G. R. Somayajulu. Studies of Joshi Effect in Nitrogen Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material. III, 219.
- Ramaswami. L. S., The squill of Gastromyzonid fishes, III, 331.

- Ramnani, D. R. and S. B. V. Rao. Infectious coryza of Fowls in India. III, 201.
- Rangayya, R. and C. Mahadevan. Geology of N. W. parts of Nellore District With special reference to origin of copper and barite. III, 171.
- Rand, D. R. and P. J. Deoras. Studies on Poona Flies 1. III, 195.
- Rao Balabheem and S. H. Zaheer. Investigations on Engobes. III, 138.
- Rao, B. Kukkuteswara and C. Mahadevan. Some observations on the interaction of Eastern Ghat rockhsuites in Visakhapatnam District. III, 173.
- Rao, B. S. Narayan and M. S. Iyengar, Alcohol Petrol Blends as Fuels in I. G. Engine, III, 232.
- Rao, B. S. Narayan, M. S. Iyengar and R. Vaidyeswaran, Influence of Conirolled Oxidation of Non-Caking Indian Coal on the Products of Low Temperature Carbonisation, III, 237.
- Rao, Bendapuri Subba. Mahi Valley Microlithic Industry, III, 45.
- Rao, B. V. Venkata and S. V. Govindarajan, Associated growth of Legumes and Cereals, III, 290.
- Rao, B. V. Venkata and S. V. Govindarajan, Phosphate manuring of legumes its influence on Nitrogen Fixation and on the yield of succeeding crop of cereal III, 300.
- Rao, C. Borreswara and C. Mahadevan. Genesis of Steatitie in Mutchukota Area. III, 171.
- Rao, C. Rama, S. Kuppuswamy, Saranya Kumari Reddy and M. Swaminath, Biological value of Proteins of synthetic grains from Tapioca and Groundnut Flour, III, 274.
- Rao, Krishna J. S. R. and C. Mahadevan. Manganese gurnets from Shipurupalle Area, Vizagapatam District. III, 170.
- Rao, C. V. N., T. N. Mehta and P. Sen. Behaviour of certain edible oils in the Frying Pan. III, 148.
- Rao, H. G. Gopal and S. V. Govindarajan, Influence of minor elements on Mysore Salts and Crops. Response of Ragi of Zinc Salts. III, 294.
- Rao, Krishna G. S., Sukh Dev and P. C. Guha. A study of the Essential Oil from the Oleo-resin of Dipterocarpus Indicus. III, 91.
- Rao, Krishna G. S., Sukh Dev and P. C. Guha. A study of the Essential Oil from wood of Cedrus Deodara. III, 91.
- Rao, K. S. Extension of the Romonovsky Bartlett-Scheffe'-Beranwin Test. III, 16.
- Rao, K. S., Tests for independent Normality in Economic Time Series. III, 16.
- Rao, K. V. Narayan and A. K. Bhattacharya. Studies in Acetone Iodine Reaction. III, 76.
- Rao, M. R., Morphogenesis of the thymus gland in Anuran metamorphosis, III, 335.
- Rao, M. V. Lakshmin arayan and M. R. Sahasrabudhe, Optimal Dietary Fat Level in relation to growth Tissue-Composition. III, 272.
- Rao, M. V. Lakshminarayan and M. R. Sahasrabudhe, Effect of Vitamin B12 on the Syntheses of Protein and Nucleic Acids in the Protein. III, 271.
- Rao, M. V. Lakshminarayan and M. R. Sahasrabudhe, Nutritive value of Vegetable Proteins in relation to Liver protein Maintenance. III, 271.
- Rao, M. V. Lakshminarayan and M. R. Sahasrabudhe, Comparative study of various fat Suppliments to the low protein diets in relation to growth and liver Fat Deposition. III, 271.
- Rao, N. Shanmukha and K. Ramachandran. Production of Levulinic acid from molasses. III, 103.
- Rao, S. B. V. and D. R. Ramnani. Infectious coryza of Fowls in India. III, 201.
- Rao, S. K. R., and N. S. N. Sastry, Towards measuring social distances. III, 287.

- Rao, P. Satyanarayan and C. Mahadevan. The Geology of the Manganese-bearing Rocks of Rayagada, Koraput District, Orissa. III, 174.
- Rao, Subba K. and S. K. Wadhawan. Studies in Soil Permeability II. The effect of ageing of the dehydrated soil on its Permeability. III, 146.
- Rao, Subba K. and S. K. Wadhawan. Studies in Soil Permeability I. The effect of temperature of dehydration of the soil on its permeability. III, 146.
- Rao, Dr. S. R. Schistosomiasis Dogs in Bombay State. III, 199.
- Rao, Dr. S. R. Eimeria Smithi as a cause of coccidiosis in cattle of the Bombay State. III, 199.
- Rao, S. V. Lakshmi Narayan. Economic Minerals of Kothavalsa area Visakhapatnam District. III, 184.
- Rao, S. Venkob, K. T. Achaya and S. A. Saletore. Chlorination of Ricinoleic acid and its Methyl ester. III, 104.
- Rao, V. L. S. P. and K. N. Mukherjee. Agricultural Land productivity of West Bengal. III, 187.
- Rastogi, M. C. and A. C. Chatterji. Adsorption of the Sols and their Constituent Ions by Freshly Precipitated Sparingly Soluble Salts Part I. III, 67.
- Rastogi, M. C. Liesegang Ring formation of the sparingly Soluble Salts of Rare Elements in Agar-Agar and Starch Gel. Part II. III, 70.
- Rastogi, M. C. Distribution of the Sparingly Soluble Salts in Periodic Structures. Part II. III, 70.
- Rastogi, R. P. and A. C. Chatterjee. Activity of Water and its Temperature Dependence in Supersaturated Solutions of electrolytes. III, 69.
- Rastogi, R. P. and A. C. Chatterjee. Role of Foreign Substances in the Realease supersaturation. III, 67.
- Rastogi, R. P. and A. C. Chatterjee. Temperature Dependence of Vapour pressure in Supersaturate Solutions. III, 68.
- Ratnam, P. V. and N. A. Ramaiah. Influence of a Strong Magnetic Field (H) on the Behaviour of Siemens' Ozonizer Giving Joshi Effect under Electric Discharge, III, 223.
- Ratnam, P. V. and N. A. Ramaiah. Influence of Wall-coatings on Joshi effect in Water Vapour. III, 61.
- Rau, M. Anantaswamy. The Endosperm in the Leguminoae. III, 23.
- Rawat, J. S., G. S. Lal and A. Roy. Hormal values of some Chemical Constituents of Buffaloe Blood, III, 263.
- Ray, C. A preliminary study of crystal-size variation in a dolerite dyke, Jamunia River, Jharia Coalfield. III, 168.
- Ray, C. Anorthosite in Chilka Area. III, 177.
- Rya, D. K., G. A. Shivani, Miss. M. Ommen and R. Bhaskaran, A study on some Coccidla of Himalayan birds. III, 314.
- Ray, D. K., On a new coccidium Eimeria hawkinsi n.s., from Indian sheep and goats. III, 314.
- Ray, D. K., Observations on the comparative efficiency of Zinc sulphate, Sugar and Salt solutions for the floatation of Coccidial cccysts of sheep & goat. III, 315.
- Ray, D. K., On a new coccidium Eimeria sphenocercae n.sp., from Sphenoceros sphenurus (Kokla green plegeon), III, 313.
- Ray, H. N. and G. A. Shivani, Treatment of equine surra in India with Antrycide Methyl Sulphate. III, 202.
- Ray, H. N., Philip A. Hawkins and G. A. Shivani. Preliminary observations on splenectomy and piroplasmosis in cattle. III, 198.
- Ray, Kumud Bhushan. Hirakund Dam Project. III, 242.

- Ray, S. and A. B. Biswas. A Biotite lamprophyre (Mica-peridotite) from the copper belt of Dhalbhum, III, 177.
- Ray, S. C., Feeding Soyabean emulsion as a partial substitute for whole milk in raising dairy calves. III, 263.
- Ray, S. N., K. Sahai and N. D. Kehar, Investigation on the optimum level of fat in the ration of ruminants. III, 267.
- Ray, Priyada Ranjan and Debabrata Bandyopadhyaya. Stability chromium (II) Biguanide and chromium (III) phenylbiguanide complexes. III, 50.
- Ray, Priyada Ranjan and Ajit Kumar Mukherjee. Inner-Metallic Complex Salts of Sulphanilamide-Salicylaldehyde and its Derivative, III, 49.
- Ray, Priyada Ranjan and Amiya Kumar Chakraborty. Complex compounds of certain Bivalent metals with Diglycyl-ethylenediamine and Determination of their Instability Constants. III, 50.
- Ray, Priyada Ranjan and Basudev Das Sarma. (On the Stability of Inner-Metallic Complexes. III, 48.
- Ray, Priyada Ranjan and Sailendranath Podder. Complex compounds of Thiodicyandiamidine (Fuanyl Thiourea) with Metallic Elements, III, 49.
- Ray Priyadarajan and Nakuleswar Kundu. Transformation of Biguanide into Dicycndiamidines. III, 100.
- Ray Burman, B., N. Patnaik and L. Mahapatra. A Note of christian oraons in sundargarh district, Orissa, III, 45.
- Raychaudhuri, S. and S. Sen. Shape analysis of Gondwana Sandstones of the Raniganj Basin. III, 188.
- Raychaudhuri, Sunilkumar and Saurindranath Sen. Structure and Petrology of a Dolerite Dyke Near Shibulibari ($86^{\circ} 44' 40''\text{E}$, $23^{\circ} 39'\text{N}$), N. Manbhum, Bihar. III. 189.
- Ray-Chaudhuri, S. P., N. N. Das Gupta and A. Guha, A new method for the study of chromosomes of grasshoppers by the electron microscope, III, 310.
- Ray-Chaudhury, S. P. and B. N. Bole Gowda, A study on the chromosomes during spermatogenesis in two spiders *Hersilia savygni* and *Steogodyphus sarasinorum*, III, 311.
- Ray-Chaudhuri, S. I. and B. N. Bole Gowda, Further evidences on the occurrence of XO mechanism of sex determination in spiders, III, 311.
- Ray Choudhuri A., T. N. Ghosh and A. K. Kundu. Search for New Antispasmodics. Part IV. III. 96.
- Ray Choudhuri Amliabha and Achintya Kamal Sen. Synthesis of 8-Aminoquinolines. III, 96.
- Ray Chowdhury, K., Colour Vision and Colour preference, III, 278.
- Ray Chowdhury, K. M., Psychic Bisexuality of Rabindra Nath Tagore, III, 277.
- Ray-Chaudhuri, S. P., and Ira Sarkar, Frenquency of anaphase bridges in the grasshopper. *Gesonía punctifrons* at different intercal after X-radiation, hopper. *Gesonía punctifrons* at different intercal after X-radiation, III, 310.
- Razdan R. K., S. C. Bhattacharyya and P. C. Guha. Study of the sesquiterpene Portion of Piper Cubeba, Linu. III, 85.
- Razi, B. A. and S. P. Agharkar, Some aspects of the embryology of *Lawia zeylanica* and *Zeylanidian olivaceum*, III, 22.
- Reddy, D. Bap, Complex factors and the behaviour of adult Rice Weevils, III, 319.
- Regulations. I, 62.
- Reddy, Saranya Kumari, S. S. Kuppaswamy, G. Rama Rao and M. Swaminath. Biological value of Proteins of synthetic grains from Tapioca and Ground-nut Flour, III, 274.

- Sriramadas, A. and C. Mahadevan. A Heavy Mineral Correlation of the Sedimentaries of East Godavary and Visakhapatnam Districts. III, 183.
- Sreenivasa, A. and R. Venkataraman, Bacteriology of salted fish and salt. II. The bacterial content of various salts. III, 330.
- Srivastava, B. N. and M. P. Madan. Intermolecular Force of Coefficient Self-Diffusion. III, 209.
- Srivastava, Durga Prasad, A. S. Chachravarti, Satrugnan Prasad and K. L. Khanna; Studies in storage of gur. III, III, 304.
- Srivastava, H. C. and S. Mukherjee. Structure of Neem (*Melia Azadiracht Indica*) Gum. Part I. HI, 114.
- Srivastava, L. N. and K. N. Johry. Formation of complex compounds between alkali nitrates and alkaline earth nitrates. III, 52.
- Srivastava, L. N. and P. C. Bose. Formation of complex compounds between potassium chloride and alkaline earth chlorides. III, 52.
- Srivastava, L. N. and P. C. Bose. Formation of complex compounds between potassium chloride and alkaline earth chlorides. III, 51.
- Srivastava R. D. and A. C. Chatterji. Adsorption from mixtures by animal charcoal. Pt. (II). (Effect one acid on the adsorption of other acids). III, 70.
- Srivastava, R. D. and A. C. Chatterji. Adsorption from mixtures by animal charcoal Pt. (I). (Effect of Salts on the adsorption of acids). III, 69.
- Srivastava, R. D. and A. C. Chatterji. Studies on the Adsorption from Non-aqueous Solvents. Pt. (II). III, 70.
- Srivastava, R. D. and A. C. Chatterji. Adsorption Equation Aplicable in solutions; III, 69.
- Srivastava, Shyma Charan, Contribution to our knowledge of the structure of the placenta of *Panthera tigris*, the Indian Tiger. III, 337.
- Srivastava L. M. and S. H. Zaheer. Improvements in the Manufacture of Fructose from Cane-Sugar by the Calcium Fructosate Method. III, 134.
- Srivastave, L. M. and S. H. Zaheer. Improvements in the Manufacture of Fructose from Cane-Sugar by the Calcium Fructosate Method. III, 134.
- Statement of Account. I, 69.
- Statistics. Statistical Problems in the Measurement of Economic Relationships—Dr. N. S. R. Sastry. II, 45.
- Subbalakshmi, Miss P. V. and G. R. Phanaskar. Oxidation of Manganese with Red Lead. III, 159 and 160.
- Subrahmanyam, K., and J. M. Senapati, Standard and maximum urea clearance value of apparently healthy individuals in Orissa. III, 254.
- Subbaratnam, N. R. and A. K. Bhattacharya. Studies in the kinetics of Iodination of Hydroxylamine. III, 76.
- Subrahmanyam N., G. M. Apparao and J. V. Sarma. Studies of Joshi Effect in 12 Vapour under H. F. Excitation. III, 58.
- Subrahmanyam, N., J. V. Sarma and G. M. Apparao. Production of Joshi Effect in 12 Vapour under H. F. Excitation. III, 220.
- Subrahmanyam, N., J. V. Sarma and G. M. Apparao. Behaviour of H₂ (1—40 mm.) under Tesla excitation. III, 58.
- Subrahmanyam, V. S. and S. Husain. Potentiometric Estimation of Cobalt and Nickel. III, 157 & 158.
- Subrahmanyam, K. and J. M. Senapati, Comparative value of the different methods of estimation of plasma proteins. III, 257.
- Subrahmanyam K., G. K. Seth and T. R. Braskaran. Effect of treatment with chemicals on the settling efficiency of lac wastes. III, 127.

- Subrahmanyam, K., T. R. Bhaskaran and M. A. Sampathkumaran, Observations on the Survival of Ova of Intestinal Parasites in some Sewage Treatment Plants Around Calcutta. III, 117.
- Subrahmanyam, V., H. B. N. Murthy and M. Swaminathan, The effect of partial replacement of rice in poor Rice diet by Tapioca on the Retention of Nitrogeon, Calcium and Phosphorus in Human Subjects. III, 273.
- Subrahmanyam, V., H. B. N. Murthy and M. Swaminathan, Effect of Partial Replacement of Rice or Wheat poor vegetarian Diets by Tuber Flours on the Nutritive Values of the Diets. III, 272.
- Subrahmanyam, V., M. R. Chendrasekhar and M. Swaminathan, Analysis of Ragi and Ragi Malt. III, 274.
- Subramanian, N., M. Srinivasan and V. R. Bhalerao, Investigations on some little known indigenous Edible Plant Materials as possible sources of Food supplements. III, 274.
- Subramanian, N. and M. Srinivasan, Investigations on some little known Indigenous Edible Plant Materials *H. Amaranthus paniculatus*: the nutritive of this seed as possible sources of food supplements. III, 273.
- Subramanyam, K. The Nutritional Mechanism of the Embryo sac and Embryo in the Families campanulactae, lobeliaceae and stylidiaceae. III, 24.
- Sundarajan, K. V., V. D. Krishnaswami and N. R. Banerjee. The Microlithic Industry of Tinnevely. III, 45.
- Sur, S. N., S. S. Guha and P. C. Guha. Studies in Antimalarials, Part IV. Some Aryl and alkyl sulphuryl diguanidines. III, 88.
- Suryanarayana B. and B. D. Tilak. Brazanquinone vat from 2:3-dichloro-1:4-naphthoquinone. III, 93.
- Suryanarayana, K. and C. Mahadevan. Correlation of some Coastal Gondwanas in Parts of Guntur and Nellore Districts. III, 182.
- Swaminath, M., S. Kuppaswamy, G. Rama Rao, Saranya Kumari Reddy, Biological value of Proteins of synthetic grains from Tapioca and Groundnut Flour. III, 274.
- Swaminathan, M., M. R. Chendrasekhar and V. Subrahmanyam, Amalysiis of Ragi and Ragi Malt. III, 274.
- Swaminathan, M., V. Subrahmanyam and H. B. N. Murthy, Effect of Partial Replacement of Rice or Wheat poor vegetarian Diets by Tuber Flours on the Nutritive Values of the Diets. III, 272.
- Swaminathan, M., V. Subrahmanyam and H. B. N. Murthy, The effect of partial replacement of rice in poor Rice diet by Tapioca on the Tetention of Nitrogeon, Calcium and Phosphorus in Human Subjects. III, 273.
- Swaroop, S., S. Chaudhuri and K. Mitra, Haematologica and biochemical studies in normal adult women of nursing professio. III, 254.

T

- Tandon, H. P. and S. G. Iyer. The influence of age of eggs on hatchability. III, 200.
- Tantry, B. A. P. and S. R. Khastgir. Atmospherics Recorder. III, 227.
- Thakral, B. M., Narayanan S. and Iyer S. G. The role of turning in relation to hatchability. III, 200.
- Thakral, B. M., S. G. Iyer and S. Narayanan. Inheritance of Smut (Slaty) under colour in Rhode Island Red. III, 201.
- Thakral, B. M., S. Bose and S. Narayanan. The processing of Cow manure for increased egg production. III, 201.
- Talapade, C. R. and M. A. Joshi, Utilisation of Samphar Lake Bitterns. III, 139.
- Tankha, V. N. La'eral Archegonia of *Pinus Roxburghii* Sargent. III, 18.

- Tewari, B. D. and N. N. S. Sidhanta. A study on Electrodeposition of Chromium-Tungsten Alloy. III, 126.
- Tawde, N. R. and G. K. Mehta. Spectroscopic Method for Determination of Electron Energy in Discharge. III, 213.
- Tawade, N. R. and G. K. Mehta. Effect of Pressure on the Excitation of Triplet and Singlet States in H_2 Spectrum. III, 213.
- Tawde, N. R. and B. B. Laud. Role of the Method of Numerical Integration in the Band Intensity Theories. III, 214.
- Tawde, N. R. and P. V. Chaudratreya. Apparent Splitting of 5460 Line of Mercury. III, 214.
- Thakor, V. M. and R. J. Parikh. Fries and Friedel-Crafts Reactions in Coumarins. III, 94.
- Thambi, M. V. and Lourdu M. Yeddanapalli. Thermal Polymerisation in Bulk of the Monophenol from Raw Commercial Cashewnut Shell Liquid. III, 75.
- Thanukrishnan, N. and K. G. Das and P. P. Pillay. Chemical examination of the Roots of *Chonemorpha Macrophylla* (G. Don.). III, 113.
- Thirumalachar, M. J. Studies on the charcoal rot disease of potatoes in Bihar. III, 37.
- Thirumalachar, M. J. and C. S. Ramamurthi. Dry rot of tubers and sprout injury in potato incited by *Aspergillus* sp., III, 38.
- Tikoo, P. K., B. M. Shukla and K. N. Khare. Role of Surface Contamination by Metallic Powders (Al and Zn) in the Production of Joshi Effect. III, 216.
- Tikoo, F. K., B. M. Shukla and K. N. Khare. Role of Surface Contamination by Metallic Powders (Al and Zn) in the Production of Joshi Effect. III, 216.
- Tilak, B. D. and K. Rabindran. Synthesis of Thiophenes and Thiaprans, Part VII. III, 92.
- Tilak, B. D. and B. Suryanarayana. Brazanquinone vat dyes from 2:3-dichloro-1:4-naphthoquinone. III, 93.
- Trivedi, A. K. M. and M. J. Patani. Constituents of Colloidal Arsenic Sulphide. III, 54.
- Trivedi, A. K. M. and M. J. Patani. Hydration of Colloidal Arsenic Sulphide. III, 55.
- Trivedi, B. S. Megaspore and other Plant Remains from lower Gondwana of Singrauli Coal Field district Mirzapur, U. P. III, 33.

U

- Usgaonkar R. N., R. C. Shah and G. V. Jadhav. Pechmann Condensation of Some 2:5-Disubstituted Phenols. III, 93.
- Upadhyaya A., B. M. Sukla and K. N. Khare. Production of Joshi effect in a Topley Evacuated Ozoniser in presence of Mercuric Iodide. III, 62.

V

- Vaidyeswaran, R., M. S. Iyengar and B. S. Narayan Rao, Influence of Controlled Oxidation of Non-Caking Indian Coal on the Products of Low Temperature Carbonisation. III, 237.
- Varier, N. S. and K. G. N. Nair, Travancore Eucalyptus Oil, III, 140.
- Varma, Brind Bihari. "Mukka-Sendra" (Women's Hunt). Among the Oraons of chota Nagpur. (Bihar). III, 45.
- Varma, P. S., H. D. Sen and R. H. Sankhala. Microbiological Production of Citric Acid. Part I. III, 120.
- Varma, P. S. and Abhaya Sinha. Analysis, Ultimate composition and Fuel value Bagasse. III, 124.
- Varshney, Y. P., Atma Ram, S. P. Krishnaswami and P. Roy. On Glass Bottles suitable for containing inks. III, 127.

- Varshney, Y. P., Atma Ram, S. C. Majumdar and K. D. Sharma. Utilisation of salt cake in the Indian Glass Industry. III, 127.
- Varshney, Y. P., Atma Ram, J. C. Banerjee and S. B. Roy. Studies on Indian Tales Part II. Properties on Firing. III, 126.
- Varshney, Y. P., Atma Ram, J. C. Banerjee and S. B. Roy. Studies on Indian Tales Part I. General Chemical and Mineralogical Characteristics. III, 126.
- Vasavan, A. C. and R. Venkataraman, Studies on salting of pomirets. III, 329.
- Venkatanarasimiya, C. B., Occurrence of Polyploidy in Scorpions. III, 312.
- Venkataraman, N. and S. K. Bhattacharyya. Studies on surface area and Catalytic activity of some Oxidation Catalysts. III, 65.
- Venkataraman N. and S. K. Bhattacharyya. Reactions in the vapour phase Part III. The catalytic oxidation of croton aldehyde to maleic acid in the vapour phase. III, 122.
- Venkataraman, R. and A. Sreenivasan, Bacteriology of salted fish and salt. II. The bacterial content various salts. III, 330.
- Venkataraman, R. and A. Sreenivasan, Bacteriology of salted fish and salt. II. The bacterial content of various salts. III, 330.
- Venkataraman, R. and A. G. Vasavan, Studies on salting of pomirets. III, 329.
- Venkataraman, R. and A. Sreenivasan, A preliminary investigation of the bacterial flora of Mackerels of the West Coast. III, 334.
- Venkataraman, R. and S. T. Chari, Studies on mackerel fat variations: correlation of plankton fat with fat of fish. III, 329.
- Venkataraman, R. and S. T. Chari. The occurrence of trimethylamine oxide in a few Indian marine fishes. III, 329.
- Venkataraman, R. and A. Sreenivasan, Preservation of semidried Prawns. II. Use of Ascorbic Acid as a preservative. III, 318.
- Venkataraman, R. and A. Sreenivasan, Preservation of semidried prawns. I. Importance of blanching and brining. III, 318.
- Venkatesh, V. The Development and growth of Cordierite in Paralavas. III, 167.
- Venkitasubramanian, T. and S. S. De, Molecular distillation of shark liver oil. III, 260.
- Venkitasubramanian, T. A., and S. S. De, The effect of lactose and galactose on the utilization of fat. III, 256.
- Vidwans, D. H. and G. R. Phansalkar. Recovery of Copper from low grade Sulphide Ores. III, 125.
- Vishnoi, H. S., On a sternal gland in Termites, III, 324.
- Visvanath, S. N. and C. Mahadevan. Aspects of the Zonal Theory of Oredeposition in the Kolar Gold Fields. III, 184.
- Visvanath, S. N. and C. Mahadevan. On the Colour of Blue Quartz. III, 170.
- Viswanathan, K. S., G. Patra and A. K. Hota. Occurrence of Irreversible Joshi Effect in Hydrogen. III, 221.
- Viswanathan, K. S., A. K. Hota and G. Patra. Influence of temperature and pressure on the threshold potential V_m , III, 57.
- irreversible Joshi-Effect in nitrogen in the hysteresis range below the threshold potential. III, 61.
- Viswanathan K. S. and E. W. Godbole. Influence of 'terminal reversal' on the magnitude of the positive and negative Joshi effect. III, 57.
- Viswanathan, K. V., M. Raghavan and P. C. Guha. Studies on Antimalarials, Part V. Some N1 and N3 substituted Derivatives of Metanilamide. III, 88.
- Viswanathan, T., S. C. Balasubramanian, M. Ramchandran, S. S. De. Amino-acid composition of Indian food-stuffs. III, 261.

W

- Wadhawan, S. K. and K. Subba Rao. Studies in Soil Permeability I. The effect of temperature of dehydration of the soil on its Permeability. III, 146.
- Wadhawan, S. K. and K. Subba Rao. Studies in Soil Permeability II. The effect of ageing of the dehydrated soil on its Permeability. III, 146.
- Walavalkar, B. R., P. R. Bavdekar and R. P. Daroga. Rate of Settling of Commercial Lime Suspensions. Part III. Effect of Particle Size of Lime. III, 148.
- Wajid, M. A. and S. Shamim Ahmad. Resonating Semipolar Single Bond Part VIII. Hyperconjugation, Strength of Acids and Calculation of Dipole Moments. III, 166.
- Wagh, R. V. On the Energy of an Isolated Fluid Sphere, III, 12.
- Walvalkar, B. R., P. R. Baydekar and R. P. Daroga. Rate of Settling of Commercial Lime Suspensions. Part I. Effect of the Amount of Water Used for Hydration. III, 147.

X

- Xavier, J. and G. S. Deshmukh, Analytical Chemistry of Thorium. Part II. Estimation by stearic acid. III, 151.
- Xavier, J. and G. S. Deshmukh, Analytical Chemistry of Thorium. Part IV. Estimation by O-tolidine, dianisidine and p-phenylene diamine. III, 151.
- Xavier, J. and G. S. Deshmukh, Analytical Chemistry of Thorium. Part V. Estimations by O-phemetidine and O-anisidine. III, 151.
- Xavier, J. and G. S. Deshmukh, Analytical Chemistry of Thorium. Part III. Estimation by Pyrogallie acid. III, 151.
- Xavier, J. and G. S. Deshmukh. Analytical Chemistry of Thorium. Part I. Estimation by m-hydroxy benzoic acid. III, 152.

Y

- Yeddanapalli, Lourdu M. and R. G. Mohan. Kinetics and Reaction Mechanism of Alkali Catalysed Reaction between Phenol and Formaldehyde: Part II. III, 74.
- Yeddanapalli, Lourdu M. and J. C. Kuriakose. Catalytic Cracking of the Monophenol from Raw Commercial Cashewnut Shell Liquid: Preliminary Investigation. III, 75.
- Yeddanapalli, Lourdu M. and M. V. Thambi. Thermal Polymerisation in Bulk of the Monophenol from Raw Commercial Cashewnut Shell Liquid. III, 75.

Z

- Zaheer, S. H. and I. K. Kacker. Syntheses of Quinazolinols. III, 102.
- Zaheer, S. H. and Balabheem Rao. Investigations on Engobes. III, 138.
- Zaheer, S. H. and V. D. N. Shastri. Note on the preparation of Vanillin from alkali lignin. III, 103.
- Zaheer, S. H. and M. D. Narasimham. Investigations of Hyderabad Clays for making Fireclay Refractories, Part II. III, 137.
- Zaheer, S. H. and Baldev Singh. Dealkylation of Bruchne. III, 102.
- Zaheer S. H. and L. M. Srivastave. Improvements in the Manufacture of Fructose from Cane-Sugar by the Calcium Fructosate Method. III, 134.
- Zaheer S. Husain and P. M. Bhargava. Condensation of Chloroacetone with Phenol and its Ethers, III, 104.
- Zoology & Entomology: The Biological Importance of the Nucleic Acids—Dr. B. R. Seshachār. II, 149.

INDEX TO PART IV

A

	Page
Aiya, S. V. C. Overhead Trans-lines.	160
Anant, P. Acid Steel Making in India	139

B

Banerjca, B. K. Propagation in Radio Waves Through Ionosphere	18
Banerjee, B. M. An Approved 'Pulse' Technique for exploring the Ionosphere	18
Banerjee, S. S. Irregularities in the Ionosphere	16
Banerjee, Sachchidananda. Symposium on animal nutrition and human	108
Baral, S. S. Ionospheric Prediction	21
Barman, Jitendra Nath, Effects of Different Lime-Stones on Basic off Production	155
Belavady Bhavani Role of Glutathione in Diabetes	115
Bhattacharya, A. P. Statistical Examination of Losses on Upper Ganga Canal	1
Bhaumik, Amulya Kumar. Service People on overlead Transmission in West Bengal	159
Bose, Bijoy Ketu. Plea for a group Therapy to absorb the Pathogenic Propensities	134
Bose, N. K. 'Thoughts on Hirakund Dam Project'	135

C

Chatterjee, Anupam, The Pathological significance of the infestation of the Diptern and its larva on animals	34
Chatterjee, D and Nagbiswas, S. C., Observations on the floral biology of sweet potato	27
Chakravarti, Nistaran C. Co-ordination of Official Statistics	97
Correa, J. P. The Eco-anatomy of the roots of some plants of Western India	24

D

Das, G. B. (Dr.). Measurement of Heat Values of Food in Indian Weights	53
Das, Saroj Kumar. Education of Youth	131
Datta, M. A Symposium Service Problem on Overhead Transmission in West Bengal	155
Datta, N. P. Micronutrient Deficiencies in Crops in Relation to Some Indian Soils	100
Deb, Chandi Charan. Role of Dehydroascorbic Acid in Diabetes	116

E

Ehrenfels, Dr. Kinship terms among the Khasis	38
Ehrenfels, U. R. Kinship Terms and Social Organization among the Khasi of Assam	38

G

George, J. C. A Note on the Cranial Osteology of Uromastix hardwickii (Gray)	35
George, J. C. and Unni Lakshmi, On the epaxial and the caudal muscles of Sauropsida	35
Ghosh, A. K. Microfossils and the Determination of the Age of Sedimentary Rocks	118
Ghosh, Naresh Chandra. Vitamin C in the etiology of diabetes	114

	Page
Ghosh, S. E. (Miss). Education of the Youth	133
Govindappa, D. A. and Sheriff A. Contribution to the Life History of Scilla indice Baker	25
Govindu, H. C. Notes on some Species of Cercospora from Mysore	27
Guha, B. C. Human nutrition and animal nutrition in relation to crop planning	109
Guha, B. C. Fermentation Technology	116
Guleri, J. Sharma. Statistical Methods in Population Studies	91
Gupta, B. M. Symposium of 'Red Rot of Sugarcane'	108
Gupta, Monoranjan, Where is Ptolemy's Kirradia?	38
Gupta, Suniti Bala (Miss). Education of Youth (Some Suggestions)	132
Gupta, T. C., Blood Pressure studies in Progressive Coarotation of the Aorta	53

I

Iyer, P. V. Krishna. Non-Parametric Methods in the Analysis of Time Series	88
--	----

K

Kapur, P. L. Proton-Proton Scattering Contribution of the p-wave	2
Khastgir, S. R. Fading in Relation to Ionosphere	15

L

Luthaer, B. R. Culture Pattern and Behaviour Problems of Youth	135
--	-----

M

Majumdar, K. K. A New Method for Analysis of Xanthates	22
Mathen, K. K. Statistical Methods in Population Studies	89
Mathur, S. N. Double Role of Respiration	51
Mathur, S. N., Further Observations on 'Colon Gastric Reflex'	52
Mathur, S. N., Reflex Control of Respiration	51
Mathur, S. N. Pressure Receptors in Arterial Branches	52
McChacken, J. and Doshi, M. S. Iron and Steel Industry in India	68
Mitra, Kalyan Kumar (Dr.). Fermentation Technology	116
Mitra, R. D. (Capt.) A discussion on the subgenerio Position of Phlebotomus (Diptera: Psychodidae)	98
Mitra, R. D. (Capt.). A discussion on the subgeneric Position of Phlebotomus (Dipteria: Psychodidae)	100
Mittra, R. D. (Capt.). Occurrence of Curiously Modified Spines on the Pulp of Pasychoda (Diptera: Psychodidae)	99
Mitra, R. D. (Capt.). Parasites of Phlebotomus (Diptera: Phychodidae)	99
Mitra, R. D. (Capt.). Parasites of Phlebotomus (Diptera: Psychodidae)	100
Mitra, S. K. Recent Advances in our knowledge of the Ionosphere	11
Mitra, S. N. Winds in the Ionosphere	17
Mukherjee, Sunil Kumar. Geography of Crop Plants	126

N

Nag, A. C. Statistical Methods in Population Studies	90
Nagabhushanam, K. Application of the spectral Theory to Time Series	85
Nair, K. K. The Chemical Composition of the pectoral muscles of some Indian birds and its bearing on their flight	36

	Page
Nanjundayya, C. Study of Yarn Characteristics with special Reference to the Region of Yarn Rupture	2
Nath, M. C. Role of Acetone Bodies in the Production Diabetes	113
Nirula, R. L. (Dr.). Symposium on the Geography of Crop Plants	126

O

Owers, N. The Occurrence and distribution of lipids in the placenta of the Indian Musk Shrew, <i>Crocidura caerulea</i>	37
--	----

P

Patel, R. P. (Dr.). Fermentation Technology Symposium	117
Pramanik, S. K. and Vegnarain, S. Diurnal magnetic variation in equatorial regions	5
Pramanik, S. K. and Rao, K. N. Hydrometeorology of the Damodar Catchment	55
Pushkar Nath. Crossibility Studies in the South American diploid species of the tuber-bearing	25

R

Rangaswami, S. (Prof.). Fermentation Technology	117
Rao, C. Radhakrishna. Discriminatory Analysis in Time-Series	89
Rao, C. B. On the Distribution of Algae in a Group of Six Small Ponds	24
Rao, K. S. Tests of Significance in Time Series	87
Ray, K. B. Salient Points of the Paper Entitled 'Thoughts on Hirakund Dam Project'	136
Ray, K. B. Thoughts on Hirakund Dam Project	135
Roy Chaudhuri, S. F. Animal nutrition and human nutrition in relation to crop planning in India	109
Roy, Topendra Ch. Steller Model with Large Radius	2

S

Saha, K. R. The latitudinal oscilation of a baro metric trough and associated weather over Bengal during the Indian Summer	3
Sarma, P. S. (Dr.). Fermentation Industries	117
Sarma, P. S. Antivitamins in the biochemical and physiological study of Vitamin Function	53
Sen, Indra. Education of the Youth	134
Sen, K. C. Human Nutrition and Animal Nutrition in relation to Crop planning in India	110
Shanmugam, T. E. Education of the Youth	133
Sharma, T. R., Om Prokash and Khan Amanulla. A study of the various types of Oil Cakes produced in Uttar Pradesh	23
Sharma, T. R., Om Prokash and Khan Amanulla. Technical Uses of Argemone Oil	22
Shrivastava, Shyama Charan. Contribution in our knowledge of the structure of Placenta of <i>Felis Tigris</i> --The Indian Tiger	36
Shrivastava, Shyama Charan. Contribution to our knowledge of the Placentation in <i>Bhinopoma Kinneari</i>	36
Shyam Chaudhuri, N. K. The Emuneration and Treatment of Tribes in the Indian Census. A study in Retrospect	38
Singh Bhoja Nath. Critical Periods in the Water Requirements of Wheat with and without Added Manures	43

	Page
Singh, Bhola Nath. Effect of Calcium, Sulphur and Phosphorus on Growth and Yield of Crops	45
Singh, Bhola Nath. Effect of Cut vs. Whole Seed, Potato on its Yield	47
Singh, Bhola Nath. Effect of Doses of Phosphorus and Calcium on Germination, Survival Percentage and Yield of Wheat	44
Singh, Bhola Nath. Effect of Forms of Combined Nitrogen, Rates and Dates of Dressings and Irrigation on Growth and Yield of Wheat and Paddy	45
Singh, Bhola Nath. Effect of Manuring, Irrigation, Fallowing and cropping in Single and Mixed Cultures on Weed Intestation of Farm Land	42
Singh, Bhola Nath. Effect of Manuring and Nutrients on Photo-synthesis	28
Singh, Bhola Nath. Effect of Overcrowding, Root and Shoot competition and spacing on Growth of Wheat	40
Singh, Bhola Nath. Effect of Nitrogenous Manures on Germination, Survival and Yield of Wheat	44
Singh, Bhola Nath. Effect of Rotation on Soil Fertility, Growth and Yield of Crops	49
Singh, Bhola Nath. Effect of Seed Rate, Manuring, Irrigation, Fallowing and Cropping of Single and Mixed Crops on Weed Intestation on Farm Land	41
Singh, Bhola Nath. Effects of Soil Types and Locality on the Production of Wheat	46
Singh, Bhola Nath. Effect of Soil Types on the Requirement of Irrigation for Wheat in Uttar Pradesh	43
Singh, Bhola Nath. Experiments on Mixed Cropping Practices: Effect of Manuring and Irrigation on Growth and Yield of Crops Grown Singly and Mixed	49
Singh, Bhola Nath. Experiments on Mixed Cropping Practices: Effect of Changing Proportionality of Seed Rates on Growth and Yield of Associates.	43
Singh, Bhola Nath. Importance of Correct Proportion of Added manures and its Economic Value in Crop Production	46
Singh, Bhola Nath. Manurial Efficiency in Determining Plant population on Unit Soil Surface and Relative Crop Returns	44
Singh, Bhola Nath. Physiological Stages as Representative of Critical Nutrient Requirements of Crops	50
Singh, Bhola Nath. The Relative Efficiency on Combined forms of Nitrogen on the Physiology of Growth and Yield of Crops Raised on Different Soils of U. P	50
Singh, Bhola Nath. The Relation of Meteorological Conditions in Wheat Production in Uttar Pradesh	39
Singh, Bhola Nath. The Relation of Respiration to Photosynthesis, Chlorophyll and Growth	39
Singh, Bhola Nath. Relative Efficiency of Methods of Sowing and Placement on Germination, Growth, Development and Outturn of Wheat	39
Singh, Bhola Nath. The Relation Between Seed Rate and Plant Population and its Effect on Growth and Yield of Wheat	40
Singh, Bhola Nath. The Response of the Respiratory System to Age and Developmental Stages of Crops	29
Singh, Bhola Nath. Residual Effects on the Succeeding Crops of Added Combined Forms of Nitrogen	16
Singh, Bhola Nath. Seed Rate and Crop Density in Crop Production	41

	Page
Singh, Bhola Nath and Balyan Babu Singh. Effect of Calcium Alone or in Combination with Phosphatic and Farmyard Manures on potato	48
Singh, Bhola Nath and Balyan Babu Singh. Effect of Seed size on Potato Production	47
Singh, Bhola Nath and Dabrai Bal Govind. Effect of Hormones on Growth Performance and Yield of Paddy	33
Singh, Bhola Nath and Dabral Bal Govind. The Relation Between Respiration and Nutrient Supply in Crop plants	29
Singh, Bhola Nath and Gupta Pateshwari Prosad. Effect of Phosphorous, Calcium and Sulphur in Varying Doses and Combination on Photosynthetic Activity of Wheat	29
Singh, Bhola Nath and Gupta Pateshwari Prosad. Effect of Size of Nitrogen Dressings on Photosynthesis and Respiration in Wheat	27
Singh, Bhola Nath and Dixit Narendra Nath. Effect of Fallowing and Cropping on Weed Intestation on Farm Land	42
Singh, Bhola Nath, and Jalote Shri Ram. The Controlling Influence of Ultra-violet and Infra-red Rays on Growth and Yield of Paddy	31
Singh, Bhola Nath and Jalote Shri Ram. Crop Nutrition Experiments:—Effect of Nitrogen, Phosphorus and Boron on <i>Phaseolus radiatus</i>	31
Singh, Bhola Nath, and Jalote Shri Ram. Effect of Day-Length on Growth, Development, Tuberisation and Yield of Potato	3
Singh, Bhola Nath and Jalote Shri Ram. Effect of Day-Length on Growth, Development and Yield of Paddy	3
Singh, Bhola Nath and Jalote Shri Ram. Effect of Day-Length on Growth, Yield and Nodulation in <i>Phaseolus radiatus</i>	3
Singh, Bhola Nath and Sharma Kailash Narain. Effect of Sulphur and Calcium on <i>Hibiscus esculentus</i>	3
Singh, Bhola Nath and Sharma Kailash Narain. Effect of Sulphur and Calcium Singly and Combined on <i>Phaseolus radiatus</i>	3
Sing, Phola Nath and Singh Chauhanja. Effect of Size of Dressing of Superphosphate on Potato	2
Singh, Bhola Nath and Singh Chauhanja. Effect of Nitrogen Doses on Tuberisation and Yield of Potato	1
Singh, Satya Narain and Rao Ramchander. An interesting case of Human infection with <i>Physaloptera</i> from Hyderabad-Dn.	1
Sinha, A. R. Co-ordination of Official Statistics	1
Sivaramakrishnan, M. V. Solar Geomagnetic Relationship from a study of Kodaikanal Records (1949-1951)	1
Srinath, K. V. and Kundu B. C. Cytological Studies of pollen tube growth in reciprocal process between <i>corchorus cup sularis</i> and <i>Corchorus olitorius</i>	1

T

Telang, M. A. Co-ordination of Official Statistics in Bombay State	1
Tischner, H. A criterion of Stability in Servomechanism System	1

V

Vaill, R., Kochhar H. L., Billimoria L. M., Khan M. Effects of Different Lime-stones on Basic Open Hearth Production	1
Visvanathan, S. Effects of Dif Lime Stones on Basis Openhearths Productions	1

PROCEEDINGS OF THE PAST SESSIONS OF INDIAN SCIENCE CONGRESS

PRICE LIST OF COMPLETE VOLUMES

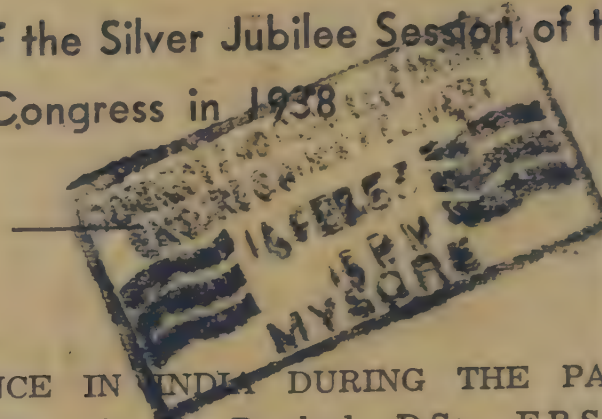
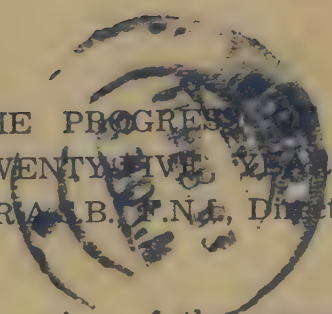
	Session	Year	City				Rs.	as.	P.
1st		1914,	Calcutta	--	--	--	0	12	0
2nd	"	1915,	Madras	--	--	--	1	8	0
3rd	"	1916,	Lucknow	--	--	--	2	10	0
4th	"	1917,	Bangalore	--	--	--	2	4	0
5th	"	1918,	Lahore	--	--	--	5	10	0
6th	"	1919,	Bombay	--	--	--	3	0	0
7th	"	1920,	Nagpur	--	--	--	3	12	0
8th	"	1921,	Calcutta	--	--	--	4	14	0
9th	"	1922,	Madras	--	--	--	5	4	0
10th	"	1923,	Lucknow	--	--	--	7	8	0
11th	"	1924,	Bangalore	--	--	--	6	12	0
12th	"	1925,	Benares	--	--	--	9	0	0
13th	"	1926,	Bombay	--	--	--	12	6	0
14th	"	1927,	Lahore	--	--	--	9	12	0
15th	"	1928,	Calcutta	--	--	--	12	12	0
16th	"	1929,	Madras	--	--	--	12	0	0
17th	"	1930,	Allahabad	--	--	--	15	0	0
18th	"	1931,	Nagpur	--	--	--	13	14	0
19th	"	1932,	Bangalore	--	--	--	18	12	0
20th	"	1933,	Patna	--	--	--	17	4	0
21st	"	1934,	Bombay	--	--	--	12	12	0
22nd	"	1935,	Calcutta	--	--	--	15	0	0
23rd	"	1936,	Indore	--	--	--	18	0	0
24th	"	1937,	Hyderabad	--	--	--	16	8	0
25th	"	1938,	Calcutta	--	--	--	30	0	0
26th	"	1939,	Lahore	--	--	--	20	0	0
27th	"	1940,	Madras	--	--	--	27	6	0
28th	"	1941,	Benares	--	--	--	30	4	0
29th	"	1942,	Baroda	--	--	--	25	8	0
30th	"	1943,	Calcutta	--	--	--	19	8	0
31st	"	1944,	Delhi	--	--	--	18	0	0
32nd	"	1945,	Nagpur	--	--	--	18	4	0
33rd	"	1946,	Bangalore	--	--	--	21	4	0
34th	"	1947,	Delhi	--	--	--	23	2	0
35th	"	1948,	Patna	--	--	--	23	0	0
36th	"	1949,	Allahabad	--	--	--	21	12	0
37th	"	1950,	Poona	--	--	--	23	12	0
38th	"	1951,	Bangalore	--	--	--	27	12	0

The publications or information about them are obtainable from the Indian Science Congress Association, 1, Park Street, Calcutta. Orders should be addressed to the Indian Science Congress Association and not to any Official by name or title.

All Cheques, Money Orders, etc., should be made payable to the Treasurer, Indian Science Congress Association. Orders for books should be accompanied by full name and address, legibly written and should be sent on a separate sheet of paper containing no other communication. In India books are supplied by V. P. P.

SPECIAL PUBLICATIONS

Issued on the occasion of the Silver Jubilee Session of the
Science Congress in 1938



THE PROGRESS OF SCIENCE IN INDIA DURING THE PAST
TWENTY-FIVE YEARS. *Edited by* B. Prashad, D.Sc., F.R.S.E.
F.R.A.S.B., F.N.I., Director, Zoological Survey of India.

A review of the researches carried out in India in different scientific
subjects during the period 1910 to 1937. Rs. 5-0-0 per copy

AN OUTLINE OF THE FIELD SCIENCES OF INDIA. *Edited by*
Sundar Lal Hora, Rai Bahadur, D.Sc., F.R.S.E., F.L.S., F.Z.S., F.R.A.S.B.
F.N.I., Assistant Superintendent, Zoological Survey of India.

An exposition of the manifold field problems involved in the study of
India of such subjects as Meteorology, Oceanography, Geology, Botany,
Zoology, Ethnology, Agriculture, Animal Husbandry, Archaeology.

Rs. 2-8-0 per copy

[Reprints of each section are also available]

The publications or information about them are obtainable from the
Office of the Indian Science Congress Association, 1, Park Street, Calcutta-10



